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VOL. CXXXVI.—No. 3541] LONDON: FRIDAY EVENING, NOVEMBER 9, 1923 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Lympne Aerodrome.

CAST IRON SECTIONAL TANKS AVAILABLE FOR DISPOSAL.

2 CAST IRON SECTIONAL TANKS, 16,000 gallons capacity, of 40 sections, each about ¾in. thick, inside measurements each tank 15ft. 3in. by 11ft. 6in. by 3ft. 6in. deep, fitted with 10 tie bars and turnbuckles, and fitted with 3in. ball valve for supply. One in good and one in fair condition.

The tanks are built into the booster house, resting on a rolled steel joist floor above the booster house, enclosed by wooden walls and roofed over.

The tanks may be seen and further particulars obtained on application to the AREA OFFICER, Works and Buildings Department, Royal Air Force, Rm 20, Billingdon House, Uxbridge, Middlesex. 4079

The Director-General,

India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—

1. COPPER WOVEN WIRE SHEETS.
2. DOG SPIKES.
3. TYRES FOR RAILWAY CARRIAGES AND WAGONS.
4. AXLES FOR LOCOMOTIVES.
5. BRIDGE WORK.
6. STEEL TUBES FOR BOILERS AND SUPER-HEATERS.
7. SWITCHBOARD CABLE, 21 PAIR, BRAIDED.
8. INSULATED WIRE V.I.E.

Tenders due on the 23rd November, 1923, for Nos. 1 to 4, and on the 29th November, 1923, for Nos. 5 to 8. Tenders forms obtainable from above. 4056

Assistant Locomotive

SUPERINTENDENT REQUIRED for the FEDERATED MALAY STATES GOVERNMENT RAILWAY for three years, with possible permanency. Salary 400 dollars a month, rising by annual increments of 25 dollars a month to 800 dollars a month, plus a strictly temporary cost of living allowance amounting to 10 per cent. of salary in the case of a single man, and for a married man 20 per cent. of salary. The Government raised exchange is now 2s. 4d. to the dollar, but the purchasing power of the dollar in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. Free passages and, if married, for wife and children also, not exceeding four persons beside the candidate selected. Candidates, age 26 to 35, must be of good education and have served an apprenticeship as a mechanical engineer in a locomotive builder's shops or preferably railway locomotive works, and should subsequently have had experience in the running department of a railway, and be well versed in modern steam shed practice and locomotive operation. A knowledge of carriage and wagon running and maintenance will be an additional advantage.

Apply at once by letter, stating age and particulars of experience, and mentioning this paper, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/12,211. 4033

In the High Court of Justice, Chancery Division, Mr. Justice Romer. 1923. E. 071.

In the Matter of the EAST COAST STEEL CORPORATION Limited and Reduced; and In the Matter of the COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that a

PETITION presented to the High Court of Justice on the 19th day of July 1923 for CONFIRMING the REDUCTION of the CAPITAL of the above Company from £5,000,000 to £4,322,814 is directed to be heard before Mr. Justice Romer on the 23rd day of November 1923.

JOHNSON WEATHERALL STURT & HARDY, Solicitors for the Company, 7, King's Bench Walk, Temple, London, E.C. 4.

The 6th day of November, 1923. 4066

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that

LYNCH GLASS MACHINERY COMPANY, a Corporation duly organised under the laws of the State of Indiana, having a place of business at corner of Central Indiana Railroad and Jackson-street, Anderson, Indiana, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 160,366, granted to Henry Fairbrother for "Improvements in Glass-blowing Machines."

Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) issued on the 31st October, 1923.

Any person or persons may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS, Comptroller-General. 4035

Belfast Union.

TO PROFESSIONAL CONSULTANT ENGINEERS.

PROPOSED CENTRAL HEATING AND LIGHTING SCHEME.

The Board of Guardians will, at their meeting to be held on Tuesday, the 18th day of December, 1923, receive from competent firms or persons qualified the above SCHEMES for the INSTALLATION and EQUIPMENT of a CENTRALISED HEATING and LIGHTING PLANT.

The Guardians will subsequently decide which is the best Scheme submitted and the person or firm submitting same will be paid the sum of One Hundred Guineas.

Information as to plan of buildings, and general conditions respecting the appointment, and the proposal form may be obtained from the Clerk of the Union on deposit of the sum of Five Guineas, which will be returned after a bona fide Proposal with the necessary documents and particulars regarding such Scheme has been received.

Proposals, sealed and endorsed "Central Heating and Lighting Scheme," with full particulars are to be lodged with me before Twelve o'clock Noon on above date.

Arrangements for inspection of the buildings, if desired, can be made on application to Mr. J. Mahood, Workhouse Master, on any day (Sundays excepted) between the hours of Ten o'clock a.m. and Twelve o'clock Noon, from whom further information can be obtained.

By Order, R. H. WILSON, Clerk of Union.

Clerk's Office, Union Workhouse, Belfast, 1st November, 1923. 4050

The Engineer

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The Motor Show at Olympia.

Science and Industry in America—No. IX.

The Wireless Exhibition.

Institution of Civil Engineers :— Presidential Address.

The History of Metallurgical Science.

Mechanical Problems of Safety at Sea.

Engineers and the Future.

Lighthouse Apparatus for Australia.

PUBLIC NOTICES

Borough of Chesterfield.

OIL-DRIVEN BOREHOLE CENTRIFUGAL PUMPING PLANT.

The Council invite TENDERS for above. For particulars apply to the undersigned.

CHAS. BOLDRY, Engineer and Manager. Water Dept., Chesterfield. 4062

County of London.

The London County Council invites TENDERS for the SUPPLY and DELIVERY in London of about 3400 TONS of STANDARD STEEL GIRDER TRAMWAY TRACK RAILS, LIPLESS TRACK RAILS, and RENEWABLE GUARD RAILS, with FASTENINGS therefor, and, alternatively, of about 5100 TONS of such RAILS, with FASTENINGS therefor.

The drawings, specification, bills of quantities, form of Tender, and other particulars may be obtained on application to the Chief Engineer of the Council, at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £2. This amount will be returnable only if a bona fide Tender is submitted and not withdrawn. All particulars may be obtained on application at the Old County Hall before payment of this fee.

Tenders must be addressed to the Clerk of the Council and delivered at the County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m. on Monday, 3rd December, 1923. No Tender received after that time will be considered.

The Council does not bind itself to accept the lowest or any Tender

JAMES BIRD, Clerk of the London County Council 4052

County of London.

The London County Council invites TENDERS for TWO CENTRIFUGAL PUMPS, together with PIPES, FITTINGS, &c., for the Isle of Dogs Pumping Station, London, E., each pump to be capable of delivering 16,800 gallons of storm water per minute.

Persons desiring to submit Tenders may obtain the drawings, specification, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, Charing Cross, S.W. 1, upon payment of the sum of £5. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the drawings, specifications and other contract documents may be inspected at the Old County Hall before payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 26th November, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD, Clerk of the London County Council. 4071

Wallingford, Berks.

SUPPLEMENTARY WATER TOWER.

The Corporation of Wallingford propose to erect a Supplementary Water Tower and Tank, to be connected with the existing Tank. They invite alternative DRAWINGS, SPECIFICATIONS, and TENDERS for the SUPPLY and ERECTION of the TOWER (a) in iron, (b) in ferro-concrete, and STEEL TANK of 70,000 gallons capacity.

Tenders, drawings, and specifications should reach my office on or before the 21st November next. The Corporation do not bind themselves to accept the lowest or any Tender.

Further information may be obtained from the Manager of the Waterworks (adjoining Railway Station), Wallingford.

FRANCIS R. HEDGES, Town Clerk. Wallingford, 3rd November, 1923. 4046

PUBLIC NOTICES

City of Liverpool.

TRAMWAY MATERIAL.

The Corporation are prepared to receive TENDERS for the SUPPLY and DELIVERY of various classes of TRAMWAY MATERIAL as under.

Firms are required to state clearly when making application for the necessary Tender forms the name and number of the schedule for which they desire to be furnished with Tender form.

Duplicate forms of Tender for record purposes will NOT be supplied.

SCHEDULE No. 1.—STEEL TRAMWAY RAILS and FISH-PLATES.
" No. 2.—STEEL FISH-BOLTS.
" No. 3.—STEEL TIE BARS.
" No. 4.—COPPER BONDS.
" No. 5.—TIMBER SLEEPERS.
" No. 6.—STEEL SPIKES.

Tender forms will be forwarded UPON RECEIPT OF APPLICATION IN WRITING to The City Engineer, Municipal Buildings, Dale-street, Liverpool.

LATEST DATE FOR RECEIPT OF TENDERS: TEN O'CLOCK A.M. on FRIDAY, the 23rd INSTANT.

WALTER MOON, Town Clerk. 7th November 1923. 4057

Southborough Urban District

COUNCIL.

WATER MAINS, &c.

The Southborough Urban District Council invite TENDERS for the PROVISION and LAYING of about 1550 YARDS of 6in. CAST IRON WATER MAIN with SCREW-DOWN HYDRANTS, SLUICE VALVES, and SPECIAL JUNCTIONS, at Southborough, in accordance with the plans and specification prepared by the Engineers, Messrs. G. and F. W. Hodson, of Bank Chambers, Loughborough and London.

Plans and specifications may be inspected at the Council Offices, Southborough, and schedules of quantities may be obtained from the Engineers on deposit with them of the sum of £5 5s., which will be returned after the receipt of a bona fide Tender and the papers.

Tenders, on the form provided, in sealed envelopes, addressed to the undersigned and endorsed "Tender for Water Mains," must be delivered at the Council Offices, Southborough, on or before Monday, the 19th day of November, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

Dated this 27th day of October, 1923.

W. N. WOOD, Clerk to the Council. Council Offices, Southborough. 3966

Tyne Improvement Commission.

20-TON HYDRAULIC CRANE WITH ACCUMULATOR AND ELECTRICALLY DRIVEN FORCE PUMP.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the CONSTRUCTION and DELIVERY at their Repairing Yard, Howdon-on-Tyne, of ONE 20-TON HYDRAULIC CRANE with ACCUMULATOR and ELECTRICALLY DRIVEN FORCE PUMP.

Copies of the form of Tender, conditions of contract, general specification and plan may be obtained on application to the undersigned on payment of a deposit of £1, which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on the cover "Tender for 20-Ton Hydraulic Crane," must be addressed to the undersigned and delivered to him not later than Noon on Friday, the 30th day of November, 1923.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order, RICHARD AUGHTON, General Manager. Tyne Improvement Commission Offices, Bewick-street, Newcastle-upon-Tyne. 7th November, 1923. 4072

PUBLIC NOTICES

State Electricity Commission

OF VICTORIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria, Melbourne-place, Strand, London, W.C. 2.

SPECIFICATION NO. 24/2.—TRANSFORMERS, SWITCHGEAR AND ACCESSORIES, SUB-STATION "B."

CHARGE.—£2 2s for the first three copies of Tender form, conditions of contract, specification, and drawings complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender. The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Noon, 19th January, 1924.

E. LIDDELOW, Secretary, State Electricity Commission of Victoria, 3922 Melbourne, Victoria, Australia.

The Great Indian Peninsula

RAILWAY COMPANY, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for :—

	Fee.
1. STEEL SPIKES	10s.
2. SPANNERS	7s. 6d.
3. SPARE PARTS of LOCO. ENGINES	7s. 6d.
4. LAMINATED SPRINGS	10s.
5. BRIGHT BRASS BARS	2s. 6d.

Tenders are due by 11 a.m. on 20th November, 1923. Tender forms obtainable at above address. Fees not returnable. 4054

The Royal Borough of Kensington.

TENDERS FOR WEIGHBRIDGE.

The Council of the above Borough are prepared to receive TENDERS for the CONSTRUCTION of a NEW WEIGHBRIDGE of twenty tons capacity at their Wharf in Kensal-road, North Kensington.

Parties wishing to Tender must furnish detailed drawings and specifications of the machine to be supplied and the price must include the construction of the necessary pit, all builder's work, and the delivery and fixing of the machine complete.

Tenders, sealed and endorsed "Tender for Weighbridge," must be delivered at the office of the undersigned not later than Four o'clock in the afternoon of Thursday, the 22nd November, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

The contractor will be required to enter into a written contract and, if required by the Council, to provide two good and sufficient sureties for the due performance thereof.

Any further particulars can be obtained on application at the office of the Borough Engineer and Surveyor at the Town Hall, Kensington, W. 8.

The contract deed will be prepared at the expense of the Council

By Order, HORACE RAPSON, Town Clerk. Town Hall, Kensington, W. 8. 3rd November, 1923. 4055

The Government of Bihar and Orissa

REQUIRE the SERVICES of a SENIOR PROFESSOR for the new COLLEGE OF ENGINEERING AT PATNA.

Five years' agreement in the first instance. Salary Rs. 1000-100-1400 per mensem. Free first-class passage to India.

Candidates, who should be not more than 40 years of age, must possess the Associate Membership of the Institution of Civil Engineers and should have teaching experience.

Further particulars may be obtained from the SECRETARY to the HIGH COMMISSIONER for INDIA, 42, Grosvenor-gardens, S.W. 1, to whom detailed application should be submitted not later than 24th November, 1923. 4034

SITUATIONS OPEN

WANTED, REPRESENTATIVES. Must be Fully qualified Engineers and Expert Salesmen.—RAGOSINE and CO., 161, Bow-road, E. 3, Lubricating Oil Merchants. 4086 A

ASSISTANT ELECTRICAL ENGINEER REQUIRED for Iron and Steel Works Department. Must have had experience in High-tension Work and preferably in Electrical Equipment of Modern Rolling Mills and Blast-furnaces.—Full particulars of technical and practical experience, also salary required, to be sent to the SECRETARY, Consett Iron Co., Ltd., Consett. 4099 A

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SITUATIONS OPEN (continued)

CHIEF ESTIMATOR and RATE FIXER REQUIRED for Machine Tool Works working on straight piecework system. Only those who have thoroughly up-to-date knowledge of Machine Tool Manufacture need apply.—Apply, in own handwriting, giving age, salary expected, and at least two references, to ALFRED HERBERT, Ltd., Edgwick Works, Coventry. 4067 A

DISTRICT LOCOMOTIVE ENGINEER REQUIRED for Colonial Railway. Age 28 to 40 years. Must have had railway experience in Locomotive Running, preferably on Colonial Railway. Commencing salary £700 per annum.—Write, giving particulars and qualifications, to Box 926, Leathwait and Simmons, 94, Throgmorton-street, E.C. 2. P8269 A

ENGINEER or SURVEYOR REQUIRED, to Assist on Large Contract, North of England. State experience, references, and salary required.—JOHN LAING and SON, Ltd., Carlisle. 4058 A

FIRST-CLASS DESIGNER, to Act Also as ENGINEER SALESMAN. Technical College training and experience in design of Pumping Machinery desirable.—Address, P8287, The Engineer Office. P8287 A

REQUIRED by Large Firm of Engineers in Provinces, having a department manufacturing electric dynamos and motors, a CHIEF ELECTRICAL ENGINEER, who will be responsible for all electrical design. He must possess high technical qualifications and hold the Diploma of a recognised Technical College or University, as well as having had practical experience in the shops. He must be experienced in the latest methods of designing D.C. and A.C. Generators and Motors, and competent to make all calculations in connection therewith, as also to issue working instructions to the drawing-office and factory.—Address, stating age, qualifications and experience, salary required, and when free to take up appointment, 4065, The Engineer Office. All applications will be treated in strict confidence. 4065 A

WILLIAMS and WILLIAMS, Ltd., Steel Window Manufacturers, Reliance Works, Chester, REQUIRE REPRESENTATIVE for London and Home Counties. Must have keen selling instincts and thorough knowledge of the trade.—Address, stating age, experience, and salary required. P8282 A

WORKS MANAGER WANTED, to Take Charge of Production in General Engineering Business in London. Must have had similar experience. Testimonials or stamps not required with application.—Address, P8287, The Engineer Office. P8287 A

A JUNIOR DRAUGHTSMAN REQUIRED for General Engineering Work in an industrial establishment in the Eastern Counties. One who has served his time in the shops and has been at least two years in drawing-office. State age, experience, and wages required.—Address, P8240, The Engineer Office. P8240 A

DRAUGHTSMAN, London District.—DRAUGHTSMAN, with shop experience and knowledge of jigs and tools and setting out machinery, REQUIRED. Permanent position likely for suitable man.—Address, giving age, particulars of experience, and salary required, 4080, The Engineer Office. 4080 A

DRAUGHTSMAN REQUIRED for Engineers' London office for detailing Structural and Mechanical Work for Coal-handling Plants, &c. Only thoroughly experienced men need apply. State age, experience, and salary required.—Address, 4081, The Engineer Office. 4081 A

DRAUGHTSMAN, Thoroughly Experienced in Mining and Concentration Plants.—Apply, stating experience, age, and salary required, to FRASER and CHALMERS ENGINEERING WORKS, Erith, Kent. 4036 A

DRAUGHTSMAN WANTED. Only Those with large experience in Colliery Winding, Haulage, and other Mining Machinery need apply. State age, experience, and wages required.—Address, 4074, The Engineer Office. 4074 A

FIRST-CLASS DRAUGHTSMAN REQUIRED, Experienced in all classes of Crane Work. Estimating experience desirable.—State age, experience in detail, and salary, with copies of testimonials, to CHIEF ENGINEER, Stothert and Pitt, Ltd., Bath. 4079 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED; none but experienced men need apply. State full particulars, age, salary required.—THE CLEVELAND BRIDGE and ENGINEERING CO., Ltd., Darlington. 4070 A

LONDON FIRM of CONSTRUCTIONAL ENGINEERS REQUIRE a smart young DRAUGHTSMAN for estimating and designing. Experience in Constructional Steel Work essential. State experience, age, and salary required.—Address, 4085, The Engineer Office. 4085 A

REQUIRED, a DRAUGHTSMAN, Skilled in Light Machine Shop Practice and Pressed Metal Work. Design and experimental experience essential.—Address, 4044, The Engineer Office. 4044 A

REQUIRED for Large Factory About 11 Miles West of London, an experienced MECHANICAL DRAUGHTSMAN, accustomed to Lay-out of Factory Plant and Mill Gearing and conversant with Structural Steel Design.—Applicants should state briefly particulars of training and subsequent service, with dates, together with salary required, to Box 116, c/o Mitchell's Advertising Agency, 1, Snow-hill, E.C. 1. 4037 A

STRUCTURAL STEEL WORK DRAUGHTSMAN REQUIRED in London district; must have had previous experience in the preparation of workshop details.—Address, stating age, salary, and previous experience, 4078, The Engineer Office. 4078 A

ASSISTANT to BOILER-SHOP FOREMAN REQUIRED by Firm making Dry-back, Loco. Type, and Portable Engine Boilers. Should be preferably man with all-round boiler shop experience, good control of men and sound organiser. Good prospects for right man. Applicants should state age and when disengaged, previous experience, and salary required.—Address, 4077, The Engineer Office. 4077 A

FOREMAN, Mechanical and Electrical, to Take Charge of Fitting and Electricians' Shops. Well up in Heavy Repairs to Mills and Gearing, Lathe and Shaft Work, and Three-phase A.C. Distribution Transmission and Motors. Only men thoroughly qualified in both branches need apply.—State age, experience, and wages, and send copies of references to Box C378, Smith's Bookshop, Corporation-street, Birmingham. P8274 A

WANTED, First-class WOOD TEMPLATE MAKERS, accustomed to Bridge and Structural Work. Society men required.—SIR WILLIAM ARROL and CO. (Swansea), Ltd., Kings Dock, Swansea. 4054 A

SITUATIONS WANTED

A. M.I.C.E. (33), Railway Locomotive Works, D.O., charge of locomotive steam sheds, automobile and general engineering, maintenance of plant, constructional, commercial experience, wide technical knowledge, speciality, organisation and control of large staffs, DESIRES POST, works or office; small salary to commence.—Address, P8263, The Engineer Office. P8263 B

BACHELOR of ENGINEERING (Sheffield University), first-class honours in mechanical engineering, age 22 years, DESIRES suitable POSITION at home or abroad.—Address, P8293, The Engineer Office. P8293 B

CIVIL ENGINEER, University Education, Chemical section, age 30, varied experience, Swedish, Danish, Norwegian, German, English, some French, REQUIRES POSITION, England or abroad.—Address, P8220, The Engineer Office. P8220 B

SITUATIONS WANTED (continued)

ELECTRICAL ENGINEER (25), Well Educated, thorough experience, power, lighting, and heating installations, DESIRES POST.—Address, P8289, The Engineer Office. P8289 B

ENGINEER and Qualified DRAUGHTSMAN (35), fifteen years' experience, home and abroad, DESIRES to get in touch with Mining or Oil Company who can offer him POSITION of TRUST either home or abroad. Experience: maintenance, construction, plant erection, or drawing-office.—Address, P8174, The Engineer Office. P8174 B

ENGINEER, Age 32, 13 Years' Thorough Practical and technical experience in general engineering, DESIRES CHARGE, Factory, Contract, or Plant; qualifications sent with pleasure.—COUMBE, 98, Crouch-hill, London, N. 8. P8252 B

ENGINEER, Electrical and Mechanical (35), DESIRES to NEGOTIATE NEW POSITION offering scope. Extensive experience in the application of steam and electrical plants for mining, textile mills, and steel works, i.e.: water-tube boilers, steam turbines, turbo-alternators, motors, and switchgear, both at home and abroad; late Capt., Royal Engineers. Has established connections in North of England. Would take position with engineering company requiring mining expert as representative for Yorkshire or South Wales or otherwise.—Reply in confidence to CAPT. ISFRYN, Park-road, Hengoed, Cardiff. 4060 B

ENGINEER (26), Mechanical, 9 Years' (2 Years' technical) experience, DESIRES POSITION as ASSISTANT or Appointment on Commercial Side.—Address, P8292, The Engineer Office. P8292 B

ENGINEER (28), Fitter, Turner, and Millwright, 10 years shops, 2½ years marine, SEEKS good permanent SITUATION, maintenance or works. Good references.—A. D., 44, Cranfield-road, S.E. 4. P8270 B

ENGINEER FOUNDER (27), Londoner, DESIRES POST, working or otherwise, in Colonies (S. Africa pref.), where exceptional abilities could be utilised. DEMONSTRATION GRATIS in difficult ENGINEERING or ARTISTIC METAL WORK, involving s.s.s.c. centre lathe, die sinking, fitting, erecting, tools and jigs; modelling, plaster casting, wood and metal patterns, sand moulding, non-ferrous melting; chasing, repousse, brazing, bronzing, polishing.—Full offer to C. P., 50, Lawford-road, N.W. 5. P8290 B

ENGINEER, with Experience in the Design, Manufacture, and running of tar-macadam machinery, REQUIRES CHANGE.—Address, P8291, The Engineer Office. P8291 B

ENGINEER REPRESENTATIVE, Age 30, Experienced, DESIRES APPOINTMENT; London preferred. Shops and D.O. training, number of years outside for leading firm; fluent French; successful business getter.—Address, P8299, The Engineer Office. P8299 B

ENGINEERS' AGENT, Live Man, Residing Manchester, well known to many large firms, DESIRES REPRESENT substantial HOUSE (whole or part time); capable negotiator, highest credentials.—Address, P8296, The Engineer Office. P8296 B

ENGINEERS' REPRESENTATIVE (35), Now Disengaged, understands mining, quarry, and industrial plants, qualified engineer and well known Swindon to Penzance, DESIRES APPOINTMENT.—Address, P8175, The Engineer Office. P8175 B

EXPERIENCED ENGINEER, with University education and first-class commercial and technical experience, several years in America, and who is shortly going to Australia, DESIRES to GET into TOUCH with large FIRMS wishing to be REPRESENTED there.—Address, P8285, The Engineer Office. P8285 B

MANUFACTURING ENGINEER SEEKS POSITION, age 37: 15 years' practical experience in charge fixing method, price, and getting work done.—Address, P8279, The Engineer Office. P8279 B

MASS PRODUCTION.—Experienced Practical AUTOMOBILE ENGINEER, important production position 12 years, on own initiative devised sound workable mass production scheme, equal Ford's, WISHES to ASSIST FIRM starting or contemplating such.—Address, P8275, The Engineer Office. P8275 B

MECHANICAL ENGINEER, with Good Record (general engineering) as foreman, cost clerk, and manager, SEEKS any responsible POST in works or office anywhere.—SNOAD, 98, York-road, Hitchin, Herts. P8305 B

MECHANICAL ENGINEER, First-class All-round practical experience, speaks French, good salesman, SEEKS BERTH.—Address, P8268, The Engineer Office. P8268 B

M.I. MECH. E. OPEN, on Completion of Agreement, for POST, home or abroad. Twenty years' experience (ten years N. America) in design, construction, and installation of power, refrigeration, materials handling, crushing and grinding plants, ferro-concrete and steel design and construction, works management and commercial experience.—Address, P8246, The Engineer Office. P8246 B

RAILWAYS, LIGHT, HEAVY.—ADVERTISER (37), wide experience, SEEKS POST, Consulting, Manufacture, Suppliers or Maintenance; used to control, good draughtsman, accustomed to home, colonial, foreign works.—Address, P8258, The Engineer Office. P8258 B

SECRETARY LADY DESIRES POSITION. Consulting or Managing Engineer (London); expert shorthand typist, accounts, interviewing, &c., common sense, long experience colliery and foundry equipment businesses.—Address, P8301, The Engineer Office. P8301 B

YOUNG DESIGNER ENGINEER (22), S.I. Mech. E., well educated, just completed articles, DESIRES CHANGE. Six years' unique experience, machine tools, special machinery, shops, D.O. and commercial designer. Excellent references. Progressive post. Live, ambitious. Make good assistant.—Address, P8286, The Engineer Office. P8286 B

YOUNG ENGINEER (24) REQUIRES CHANGE of POSITION. All-round experience on centrifugal pumping installations and good knowledge of steam condensers and D.C. electrical machinery; home or abroad.—Address, P8277, The Engineer Office. P8277 B

DRAUGHTSMAN, with General Engineering Experience, SEEKS POSITION in London or district; also good surveyor and leveller.—Address, P8271, The Engineer Office. P8271 B

DRAUGHTSMAN (32), with Good Experience of steel-framed buildings and light constructional steel work, details and design, used to London practice, DESIRES CHANGE.—Address, P8294, The Engineer Office. P8294 B

DRAUGHTSMAN, 5 Years D.O., Die Casting, detailing jigs and tools, lay-out of plants, well up in figures and general engineering, REQUIRES POST.—Address, P8285, The Engineer Office. P8283 B

DRAUGHTSMAN (27), with Prac. Exp. in Design of automatic — patent — weighing — hoisting — conveying—machines, with math. and tech. training SEEKS progressive POST at Gen. Engineers.—AUSTIN, 29, Lyham-road, S.W. 2. P8273 B

DRAUGHTSMAN REQUIRES EVENING WORK; general arrangements, details, tracings, or stress diagrams.—BRYANT, 48, Plantagenet-street, Riverside, Cardiff. P8288 B

SITUATIONS WANTED (continued)

JUNIOR DRAUGHTSMAN (22) DESIRES CHANGE 8 years D.O. and shops, general, thoroughly used to detail work.—Address, P8278, The Engineer Office. P8278 B

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For continuation of For Sale Advertisements see page 3

A Seven-Day Journal

Some More L.C.C. Tramway Schemes.

From the report submitted by the Highways Committee at the last meeting of the London County Council, we learn that four new schemes of tramway extension, involving a total estimated expenditure of nearly £600,000, are under contemplation. All four are stated to be justifiable "by special grounds of urgency." Nevertheless, it requires little perspicacity to criticise them. The four extensions have a total length of 7 miles, and will cost for their construction and equipment, exclusive of road widening and other works, £456,546, or over £65,000 per mile. Dividing the issued capital of several British railways by the mileage of track—reduced to the equivalent of two lines throughout—we find that the capital invested per mile of track owned varies from £32,000 for the Great Western to £50,000 for the London and South-Western. It may, of course, be argued that the railways were mainly constructed when labour and material were much cheaper than they are to-day. On the other hand, the estimated cost of the new tramway extensions is just about four times what similar extensions cost per mile in the years before the war. Two of the schemes seem to us to be particularly ill-advised. At present the Council's cars stop on the south bank of the Thames in Southwark Bridge-road and Waterloo-road. It is proposed, for the convenience of City workers, to carry the lines across the river by way of Southwark and Waterloo Bridges at estimated costs of £48,765 and £30,300 respectively. These sums are equivalent to £156,000 and £81,000 per mile. A census taken on the 5th ult. showed that under 6000 people crossed Southwark Bridge from the cars on their way to the City during three hours in the morning, or from the City to the cars during a like period in the evening. Moreover, from the figures given by the census, it is clear that the cars were arriving or leaving with not more than thirty passengers on board each, on the average, or, in other words, that they were running half empty.

Lambeth Bridge.

Another matter now under consideration by the London County Council is the reconstruction of Lambeth Bridge. The existing bridge was completed in 1862 at a cost of £48,924. It is of the stiffened suspension type, divided into three equal spans of 268ft. by piers and towers carrying the suspension cables. Between the parapets it measures under 32ft. In 1879, when it was taken over by the Metropolitan Board of Works, its condition was far from satisfactory, the cables and girders having suffered greatly from rusting. As much as 16 lb. of rust are stated to have been removed from a piece of cable 5ft. long. In 1887 the late Sir Benjamin Baker condemned the design, the method of construction, and some of the materials used in the bridge, and, as a consequence, certain repairs were executed. In 1892 the bridge was regarded as being in a dangerous condition, and as requiring to be rebuilt. Precedence, however, was given to the rebuilding of Vauxhall Bridge. In 1903 and 1904 the reconstruction of Lambeth Bridge was again proposed, but on both occasions nothing was done. In 1905 it was necessary to restrict vehicles crossing the bridge to 2½ tons in weight, and to walking speed. In 1910, in the interest of public safety, the bridge was closed to vehicular traffic. On two occasions since that date parliamentary powers to rebuild the bridge have been sought by the Council and have not been secured. It is now proposed that Parliament should be asked to sanction the construction of a steel arch bridge, 60ft. wide, estimated to cost, exclusive of extensive and expensive approach works, £600,000.

Dublin Dockyard and Vickers.

At a recent meeting of the Dublin Port and Docks Board a motion was passed under which the lease of the premises held by the Dublin Dockyard Company will be transferred on the same terms to Vickers Limited. At the meeting reference was made to a rumour that Vickers were acquiring the yard, not for the firm's own use, but to prevent competitors from obtaining it. It was declared emphatically that there was no truth in the suggestion, and that although there was very little prospect of the establishment being worked in the near future at any material profit, it was hoped to open it within thirty days provided labour conditions were satisfactory. It was, further, indicated that Vickers hoped to introduce industries not previously carried out at the yard, bridge building being specifically mentioned in this connection.

German Yard Measures.

What looks exceedingly like an ingenious instance of "slimness" on the part of some Germans has recently been detected by the London Chamber of Commerce. In connection with goods sold by length, numerous complaints have been received by British manufacturers and exporters from overseas buyers, the allegation being that the measure was short. The complaints were received in particular from Japan and from South American countries. On investigation it was found that the complaints had their origin in the use by the oversea customers of tape measures made in Germany. On one side, as inspection of a sample tape clearly revealed, metre measurements were accurately given, but on the other the divisions were in accordance with the old German yard or "elle" of 37in. The Chamber of Commerce has taken steps to warn its correspondents abroad concerning the matter, and has directed the attention of the Board of Trade and Department of Overseas Trade to it. It is evident that the use of these erroneous German measuring tapes may readily result in British commercial prestige suffering grave injury. It might be worth our exporters' while to send a certified British-made measure to each important overseas customer.

America and the Zeppelin Patents.

The interest of those who are advocating with renewed vigour that we should proceed actively with the development of the airship, has been aroused by the announcement that an American company—the Goodyear Tyre and Rubber Company, of Akron, Ohio—has purchased all the patents and rights relating to the manufacture of Zeppelin airships. The purchase price has not been disclosed, but it is stated to be very large. It is not clear whether the purchase covers the right to use the patents in the United States, or whether a world-wide assignment has been made, but the latter is almost to be inferred from the statement which has been made that the town of Akron will now become the centre of the dirigible airship building industry. That town, it may be recalled, has long been associated with the construction of airships, not always, however, with good fortune. It was there that the Vaniman-Wellman airship America was built, which was abandoned during an attempt to cross the Atlantic in 1910, and it was there also that two years later a second example by the same designer exploded, causing the loss of five lives.

Developments at Croydon Air Station.

Some time ago it was officially decided, after lengthy investigation, that it was not, for the time being, at all events, desirable to give up Waddon Aerodrome, near Croydon, as London's "air port" in favour of any other suggested site. In announcing its decision in this matter, the committee appointed to consider it indicated in what respects it would be necessary to increase the facilities at Waddon to accommodate the expected growth of civil air traffic. Detailed plans have now been prepared to give effect to the committee's proposals, and when they have been carried out Waddon, it is said, will become the largest air station in the world. The work contemplated includes road diversion, the acquisition of many additional acres of ground, the erection of new bonded warehouses and Customs sheds, and the construction of some large reinforced concrete hangars. In addition, a new hotel is to be built, and a railway station is to be provided at the aerodrome in order that passengers may be brought by electric train from Victoria or London Bridge direct on to the ground.

An Automatic Telephone Contract.

In a letter to the Press, Mr. J. M. Hogge alleged a few days ago that the Post Office had entered into a contract understood to be of a value approaching a million pounds sterling for the supply of Strowger automatic telephone equipment for 50,000 lines in the London area. Ultimately, it was estimated, the complete equipment of the metropolitan system with automatic telephones would involve an expenditure of something like ten million pounds. Mr. Hogge expressed strong disapproval of the telephone authorities' action in thus sending to Chicago work which, if kept in this country, would have helped materially in the relief of unemployment. The Postmaster-General lost little time in replying to Mr. Hogge to the effect that he was completely misinformed, and that all the equipment required would be made in this country by British labour except possibly in the case of a few special details which could not be made here, and which accordingly would be obtained from the United States.

New Works on the Railways.

It is officially announced that the London, Midland and Scottish Railway Company intends to spend £4,000,000 on overtaking arrears of maintenance and renewal, constructing and repairing locomotives, carriages, wagons, &c., and constructional work in connection with the replacement of machinery. This programme will lead to all the company's manufacturing and repairing shops going on full time, and thus benefiting the towns of Crewe, Derby, Horwich, &c. The company further proposes to spend £10,000,000 on such new works as the building of stations, widenings of the main line, additional loops and increased siding accommodation. Thirty bridges on various parts of the line are to be partly rebuilt or otherwise strengthened. The Southern Railway Company has also announced its plans. Its programme includes the electrification of the former South-Eastern and Chatham, further electrification on the Brighton system, and the completion of the South-Western programme of electrical services, *i.e.*, the extension to Guildford, *viâ* Claygate and *viâ* Leatherhead. Six stations are to be rebuilt, the Basingstoke and Alton light railway is to be restored, and the Totton-Fawley, near Southampton, to be built. The London and North-Eastern Company has supplemented the programme outlined in this page of our issue of the 19th ult. The sum of £1,250,000 is to be spent on locomotives, and £2,500,000 on wagons; a carriage-building programme is also being prepared. Some portion of these orders will be placed with outside firms. The renewal of the permanent way and strengthening of several bridges are to be undertaken on a very liberal basis.

The Peninsular Locomotive Company.

In the Journal for October 6th, 1922, we recorded the fact that Kerr, Stuart and Co., Limited, had accepted the invitation extended to them early in 1921 by a group of influential Indian gentlemen to form a company in India for the manufacture of railway locomotives. In pursuance of the scheme, an undertaking known as the Peninsular Locomotive Company was formed, in which Messrs. Kerr, Stuart hold a controlling interest and of which they have been appointed managing agents for a period of thirty years. A considerable proportion of the work on the orders received in India by the Peninsular Company, for which the raw materials are not yet available in that country, will be carried out at the Stoke-on-Trent establishment. According to the directors' annual report, to be submitted to Kerr, Stuart's shareholders on the 12th inst., the Peninsular works have now been practically completed, and will be in a position to tender for next year's locomotive requirements of the Indian Government. The works, we understand, are situated at Tatanagar, but as to their size, capacity, or the number of workpeople employed, we have no information.

Railway Labour.

As we go to press, the National Wages Board—presided over by Sir William Mackenzie, and of which four of the sixteen other members are representatives of the public—is commencing the hearing of the application of the railway companies for a modification of the concessions made in what is known as the National Agreement of March 27th, 1919. The modifications are being opposed by both the railway unions, one of which—the Associated Society of Locomotive Engineers and Firemen—is, moreover, asking for further benefits. The concessions which it is now sought to modify come on the top of the minimum pay of railwaymen having been raised to 100 per cent. over the pre-war standard, and of the institution of the eight-hour day. It must now be recognised that the companies were too generous, but when the revised terms of service were agreed to in March, 1919, a very hopeful spirit prevailed. To the railway companies the present hearing is causing some anxiety. One reason for this anxiety is that the statement of their case will anticipate the similar step to be taken when the proposed standard charges come before the Railway Rates Tribunal for adjudication. The companies are further handicapped by their large reserves, some of which they are now, apparently, going to spend on renewals of bridges and other works, as indicated in a preceding paragraph.

Minor Advantages of Oil Fuel at Sea.

In the course of his exceedingly interesting Hawksley Lecture delivered last Friday before the Institution of Mechanical Engineers, Sir Westcott Abell incidentally drew attention to several minor but none the less highly important advantages attendant upon the use of oil fuel on board ships. Dealing, for instance, with the vexed question of the subdivision of the hull, he pointed out that in an oil-burning or motor ship the fuel was usually contained in side bunkers, the inner walls of which, running parallel with the ship's sides and some 15ft. inwards, formed an inner skin below the water line. The ship's safety was additionally increased by subdividing the oil bunkers by transverse bulk-heads spaced about 20ft. apart. Again, in connection with the provision of openings in the main bulkheads, the oil-driven ship, Sir Westcott pointed out, had the advantage from the point of view of safety that such openings could be made comparatively high up in the ship, whereas if coal were the fuel, they had to be low down at the level of the furnaces. The watertight doors, whether operated manually or by power, employed to close the openings in emergency, stood, he continued, a better chance of working effectively in an oil-driven than in a coal-fired vessel by virtue of the absence of dirt and dust. Some advantage would also appear to reside with oil fuel in the matter of fire extinction, for the fact that there are no interstices in the oil permits the application to it of fire-extinguishing preparations in a very ready manner.

THE UNITED STATES BUREAU OF STANDARDS, WASHINGTON.

GENERAL VIEW OF THE ESTABLISHMENT TAKEN FROM THE AIR

EXPERIMENTAL WIND TUNNEL

PAPER MAKING MACHINE

Science and Industry in America.

By WALTER ROSENHAIN, D.Sc., F.R.S.

No. IX.*

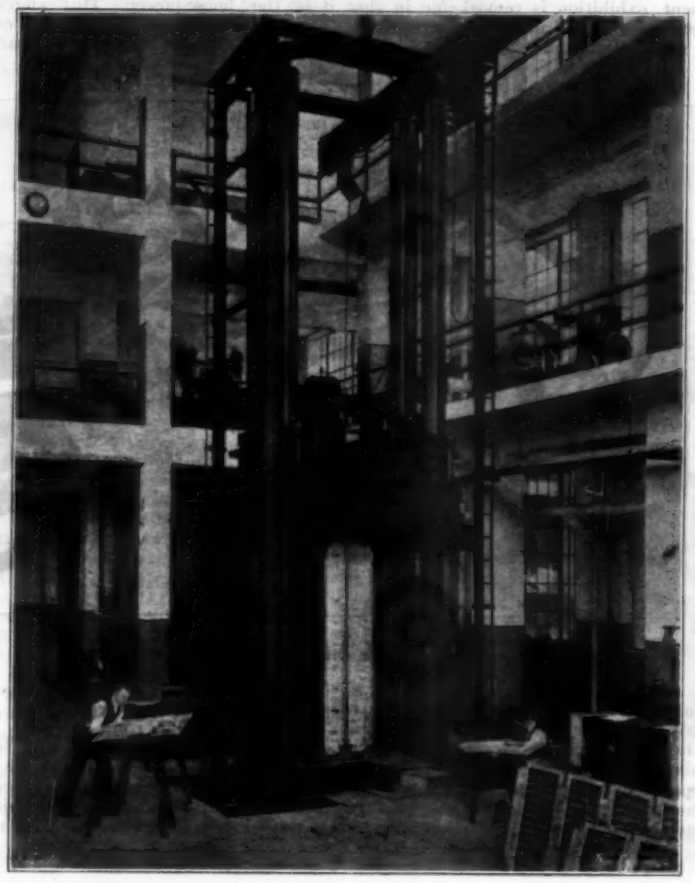
THE GEOPHYSICAL LABORATORY.

THE Geophysical Laboratory at Washington, in certain respects, resembles the Mellon Institute, since both rely upon foundations and are not dependent upon either fees or annual grants for their income. The source of the funds for the Geophysical Laboratory is the Carnegie Foundation, so that the laboratory is, financially, in a very enviable situation. Its geographical situation is equally enviable, since it has been placed most fortunately upon a picturesquely situated wooded hill in the vicinity of Washington, not many hundred yards from he United States Bureau of Standards, and amid extremely pleasant surroundings. The buildings are not very large nor pretentious, but the visitor is at once impressed by the fact that here is a working laboratory devoting itself exclusively to scientific research unhampered by considerations of red tape, or by the necessity of securing political or other popular support. Situated as close as it is to the Bureau of Standards, a certain amount of comparison is almost unavoidable. In regard to size, the Government Institution is, of course, enormously the larger, and there can also be no comparison with regard to equipment or number of staff. On the other hand, there is a very distinct difference of atmosphere, a difference very much in favour of the Geophysical Laboratory. Not only is the latter Institution devoted to research pure and simple, but the conditions of work and methods of administration are especially adapted to research work, whereas at the Bureau of Standards, as will be remarked below, methods of administration, which may be more or less suitable to administrative Government Departments, have been forced upon a scientific Institution.

The character of the work produced by the Geophysical Laboratory at Washington is well known and appreciated over the whole world. The study of the constitution of various ternary systems, such as silica-lime-alumina and others, which are of fundamental interest, not only from the point of view of physical geology, but from that of the study of refractory materials, has produced a mass of new and valuable data which form the foundation of a modern development of ceramic science. The work on silica and its various modifications, quartz, tridymite, and crystobalite, is also well known and has proved of the widest industrial importance. Reference to this work is particularly appropriate here on account of

* No. VIII. appeared November 2nd.

the fact that, although undertaken from a purely scientific standpoint and for the purpose of clearing up the character of the changes which have taken place in rock magmas under geological conditions, it has yet proved of the greatest practical importance, while a large number of researches directed towards the improvement of refractory materials and the solution of other ceramic problems have proved comparatively futile. This is but another example of the general principle that advancement of knowledge is the true function of research, and that when research fulfils this function in the best manner, practical results are bound to flow from it, whereas researches directed to immediate practical ends are apt at times to miss their mark and produce little of value. In addition to the work on the equilibria of systems of rock-forming minerals, a large amount of work is also done at the Geophysical Laboratory on the effects of very high pressures. In connection with the former work the names of Day, Sossman, and White are well known. In connection with the latter the work of Johnston and Adams has not perhaps attracted so much attention in the outside world, but has none the less been of very great importance. Dr. Johnston has now moved to become professor of chemistry at the new Sterling Laboratory at Yale University, but Dr. Adams is continuing his work on high pressures. This work links up, to some extent, with that of Bridgeman at Harvard, to which reference has already been made. It is certainly interesting to find two distinct laboratories devoting their attention to these problems of extremely high pressures, and it may be significant of an almost unconscious prevision of the fact that in the near future the problem of dealing with very high pressures indeed may become one of great practical as well as scientific importance. It has been suggested, for instance, that, having to a considerable extent conquered the air, man may next proceed to a conquest, on a much larger scale than has yet been achieved, of the earth. The problem has received more or less speculative consideration from a number of scientific men, including Sir Charles A. Parsons, and the problem of the high pressures involved always arises as the most likely limiting factor to any efforts in that direction. Apart from hypothetical applications, however, an extension of our knowledge of the behaviour of matter under extremely high pressures combined, if possible, with high temperatures is of very great interest in extending our knowledge to a wider range of physical conditions.



10,000,000 lb. TESTING MACHINE

The work of the Geophysical Laboratory on rock-forming minerals has naturally led to a considerable degree of interest being taken in the internal structure of crystals, and consequently it is not surprising to find an extremely well-equipped laboratory attached to the Geophysical Laboratory, designed for dealing with the study of crystals by means of X-ray analysis. In the hands of Dr. Wyckoff this installation is already yielding valuable results.

An object of particular interest at the Geophysical Laboratory is the collection of instruments, mainly designed for the accurate measurements of high temperatures, heat quantities, &c., many of them designed by Dr. White. This investigator has probably carried this particular subject further than has been done elsewhere, and many of those appliances are most original and beautiful. At the same time, in connection with them a point may be mentioned which requires discussion in order that future misunderstanding may be avoided. It is a general point which applies to a number of instruments and appliances in use in various laboratories. It arose, however, in connection with a special form of potentiometer which Dr. White had in use and which was being manufactured by the Leeds and Northrupp Company as the "White" potentiometer. The instrument in question is simply a potentiometer of a constant resistance type, in which the resistances are so arranged that the total resistance in the galvanometer circuit is constant for all readings of the potentiometer, thus leaving the instrument equally sensitive so far as deflections of the galvanometer are concerned at all parts of the scale. An instrument of this kind has been used and described by Stansfield in one of the reports to the Alloys Research Committee in England prior to 1904, and it is by no means certain that the instrument was original with him at that time. Dr. White himself was obviously quite unaware of the previous use of an instrument of this type, and would not for a moment have allowed his name to be used in connection with it if he had not believed the design to be original. Cases of this kind, as has been suggested above, are by no means uncommon in America, and there is every probability that similar mistakes are inadvertently made in England and elsewhere. No doubt this duplication arises from the difficulty of following the details of widely scattered literature, special instruments being sometimes described in papers in which one would not particularly have looked for work of that kind. For instance, Dr. White may well be pardoned for being unaware of a publication dealing with a special type of potentiometer occurring in a purely metallurgical paper. It may be hoped that the establishment of the *Journal for Scientific Instruments* in this country, in which descriptions of special instruments may be given, quite apart from the general purpose for which they are used, may obviate this difficulty to some extent. Although there may be a more or less unavoidable tendency towards ascribing credit for an invention or discovery, even for the details of an instrument, to one's own countrymen, this tendency is largely a matter of want of knowledge of the details of foreign work. As between England and America, at all events, it is hardly credible that a misguided form of patriotism could lead any scientific worker intentionally to ascribe to one side of the Atlantic any work which has been done on the other.

THE BUREAU OF STANDARDS.

The United States Bureau of Standards at Washington is of unique importance in regard to the relation of industry and science in America. It is, to begin with, the largest institution in America, and perhaps in the world, which is devoted mainly to the application of science to industry. In many ways its functions are very similar to those of the National Physical Laboratory in England, but it differs in a number of important respects. In the first place it was originated as a Government institution, and has grown to its present size under those auspices, largely as a result of war conditions. The immense financial resources of America, both governmental and industrial, have given to the Bureau of Standards for many years past the command of resources far greater than those which have ever been devoted to similar work in England. Even at the present time, although the appropriation for the Bureau of Standards was very materially reduced at the end of the war, the funds at its disposal (about 1,300,000 dollars per annum) are proportionately very much greater than those of the National Physical Laboratory in England. Another distinction of some importance is that the United States Institution is almost entirely unrestricted in regard to the scope of its work, so that its activities extend not only over the whole domain of chemistry and its industrial application, but cover such industries as paper-making, textiles, ceramics, &c., which are regarded—rightly or wrongly—as lying more or less outside the scope of the corresponding British establishment.

A general idea of the Bureau of Standards may be gained from a photograph of the building taken from the air, which is reproduced here. The older buildings are those occupying the middle and right-hand foreground of the picture. They are devoted to physics, chemistry, metallurgy, electricity and aeronautics, and other branches of scientific work. The newest and largest building is that on the left-hand side of the picture, showing a large frontal bay with three wings projecting backwards, and a long low building at the rear with a tall chimney. This whole large group of buildings is known as the Industrial Research building and houses such appliances as the large ten million pound testing machine, the paper-making machine, and the department connected with ceramics and glass. A full-size plant for the manufacture of optical glass is housed in the low building with the chimney already referred to. Not visible in the aerial photograph, but nevertheless forming a striking feature of the appearance of the Bureau of Standards buildings is the large wind tunnel used for experiments on aeroplane models. This is a long circular tunnel 10ft. in diameter erected in the open air. The central part of the tunnel is surmounted by a building which houses the balances and other apparatus required for use in connection with the tunnel, as shown in the illustration. An open air wind tunnel of this kind is, of course, a much less expensive installation than a tunnel of corresponding size enclosed in a building, but its use is limited to days on which the effect of the wind is negligible.

TESTING MACHINES.

The activities of the Bureau of Standards cover so wide a field that it is only possible to refer here to a few selected examples. Perhaps the most striking item of equipment of this great laboratory is the ten million pound testing machine already referred to, which is also illustrated. It is a very large vertical machine, used mainly for compression tests on long heavy columns. Work done with it includes tests on full size steel sections, on the skeleton girders used in rigid airship construction, and on massive piers of reinforced concrete, bricks set in cement, &c. The great height of the machine is provided for by the construction of the building, the machine itself being placed in a sort of central tower passing through a number of storeys; surrounding it are galleries carrying the smaller testing appliances. The great height makes it possible to test full size members of considerable length, and full advantage of this is being taken in connection with the construction of a rigid dirigible airship by the United States authorities now in progress at Lakehurst, near Philadelphia. The general type of girder used for this construction, however, is still very similar to that used in other rigid airships, particularly of the Zeppelin type.

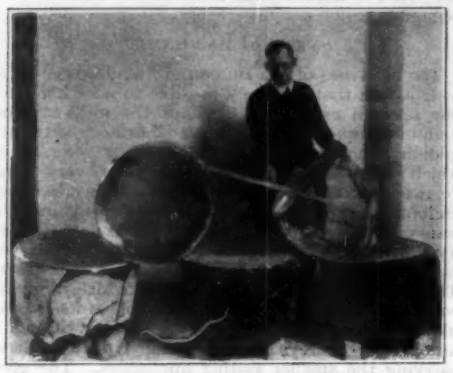
In connection with the testing of full size steel members, some interesting work has recently been carried out in making comparisons between rolled sections and built-up sections—I-beams—of theoretically equal strength. When testing the behaviour of these large steel members, it is desired to ascertain particularly the exact mode of deformation which takes place in the web. In order to do this in the ordinary way it would be necessary to make a very large number of measurements of lines and other marks made upon the web. This laborious method has been avoided by an ingenious device, which consists in coating the surface of the steel, prior to the test, with a thin wash of Portland cement. It is found that this thin wash cracks off in well-defined lines along the regions of most severe deformation, thus covering the surface with a pattern which it is easy to interpret as indicating the degree of deformation taking place at each part of the web. The difference between the riveted built-up girder and the rolled section in regard to web deformation is very strongly brought out by examining pieces treated in this way prior to being tested to destruction.

Besides the great testing machine already mentioned and an Emery machine of the horizontal type somewhat similar to that in use at Watertown Arsenal, the Engineering Division of the Bureau of Standards is equipped with a large variety of other types of testing machines, including most of those which are well known and used both in England and America. Although the main American activities in regard to research on fatigue are centered at the University of Illinois, a considerable amount of experimental work on fatigue is also carried out at the Bureau of Standards. It relates mainly to the behaviour of light aluminium alloys, notably Duralumin, when subjected to alternating flexure in the form of strips of thin sheet. On the whole, the results obtained by the Bureau of Standards are in good agreement with those accepted elsewhere, but a few results have been

obtained which, if confirmed in repetitions of similar experiments, suggest that if the application of alternating stresses is continued long enough, breakdown may occur even at stresses considerably below what is now regarded as the fatigue range. The whole question of ultimate endurance over a very prolonged range of alternation is receiving a great deal of attention at the present time. Where pieces of metal are exposed to many hundreds of millions of alternations in their useful life, inquiries of this kind are particularly important, and it is now fully recognised that an endurance of one million or even six million reversals does not necessarily prove the capacity of resisting that particular system of alternating stresses indefinitely, and tests up to many hundreds of millions of reversals are now being carried out.

GLASS.

The engineering equipment just referred to occupies the central portion of the Industrial Research building. Upon one side of it is the section devoted to the study of problems relating to paper making, and a full size paper making machine, which is illustrated, is installed. Another section of this building is devoted, as has already been indicated, to ceramics and glass. The volumetric testing of chemical glassware, which is carried out in one of the rooms of the physics division of the bureau, has not attained any important dimensions in America. On the other hand, the question of the power of glass to resist chemical action has received much attention, not only from the point of view of chemical glassware, but of arriving at standards of durability and resistance which shall be applicable to glass used for ordinary domestic purposes, both in the form of glasses—tumblers—and jars for fruit preserving and similar purposes. The work of the bureau has been directed to an endeavour to establish standards which could reasonably be expected of ordinary domestic glassware from this point of view, and they



SAMPLES OF GLASS MADE AT THE BUREAU

have in their possession a very interesting series of specimens showing wide variation in the degree of durability and resistance met with in ordinary commercial products. This particular investigation and the resultant specification for domestic glassware, is typical of one side of the activities of the bureau, which are directed to the solution of specific commercial problems, sometimes suggested to the Bureau by the industry and at other times taken up in order to meet some public demand or to overcome some difficulty which has aroused public attention. The activities of the ceramics division, which deals both with ordinary pottery and porcelain as well as with refractories, are again directed to the solution of a variety of problems, mostly raised by the industry, and in many cases relating to the utilisation of American products and raw materials for special purposes. The pots or crucibles which have been successfully used in America for the production of optical glass have been evolved as the result of researches of this kind. The pots in question are of a porcelain-like nature differing very widely from the ordinary fireclay pots in general use by glass manufacturers in this country.

Particular interest attaches to the efforts which have been made by the Bureau of Standards during the war and subsequently to remedy the shortage of optical glass which has made itself felt in America. While one may rightly regard the true problem in connection with optical glass to consist in the production of the material under commercial conditions, and as a self-supporting, not to say dividend-paying industry, the problem under war conditions was of a somewhat different nature, an adequate supply of optical glass being absolutely essential to the conduct of the war. On this ground, the erection of a full size plant for the production of optical glass in considerable quantities at the Bureau of Standards can be justified. Actually, a number of similar efforts at the production of optical glass were made by certain private firms in the United States, but most of them have now abandoned the work. The plant erected at the Bureau of Standards does not differ very appreciably from that used for the production of optical glass in older factories. Perhaps the most outstanding feature is that all the glass is melted in open pots, the control of the flame being sufficiently good to prevent injury even to heavy lead glasses. Stirring is carried out in the orthodox manner except that it is begun before the glass has completely freed itself from raw material or enclosed gas bubbles, and that it is carried on continuously by mechanical means instead of intermittently by hand as in the older factories. It is not, of course, possible to obtain any estimate of the percentage yield of successfully-usable optical glass which has been obtained in this plant, as it has been operated under very exceptional conditions differing widely from those of commerce. A quite considerable quantity of good quality optical glass has, however, been produced, and the material at present in stock at the Bureau of Standards is sufficient proof of the really high degree of success which has been attained. Some of these products are shown in the photograph which is reproduc here, showing three large pieces of glass representing whole meltings in a single block, and two other pieces suitable for the production of large telescope objectives.

The Motor Car Show at Olympia.

No. II.*

It is claimed, quite justly, no doubt, that the present exhibition is remarkable in that it is the largest assembly of motor cars ever displayed under one roof. We should say that it is equally remarkable for what it does not display as regards the engineering side of the motor car. In a sense, this may be taken as a compliment to the motor industry, for it shows that motor car buyers in the main are now prepared to take for granted all that the makers tell them with regard to engines, gear boxes, transmission systems, &c. Most of these have long since passed the experimental stage, although minor changes are still being made from year to year. Four wheel brakes are being fairly extensively adopted, overhead valve systems have displaced side-by-side valves to a considerable extent, and gear-boxes are now being made with four-speed ratios, but all these points are at present outweighed by consideration for the comfort of the passenger. In other words, this year's Show is more of a coach-builders' exhibition than any of its predecessors, and it must be admitted that this branch of the industry has taken full advantage of the opportunity. Thanks in a very large measure to the improved machinery now provided by engineers, the handicraft of the coach-builder has been replaced by manufacturing methods which enable him to supply motor car bodies suitable for the British climate much more cheaply than was formerly the case. Motor vehicles are now regarded more as general utility machines than implements of pleasure, and it is, therefore, essential that they should be capable of being adapted to all conditions of weather. Hence the demand for "all-weather" and saloon bodies, and in satisfying this call a good deal of ingenuity is being displayed. With modern high-efficiency engines it is found that saloon cars do not necessarily involve very high power units.

An excellent example of an all-weather body is found in the 11.4 horse-power Humber car, an illustration of which is given in Fig. 23, page 506. This car provides ample and almost luxurious accommodation for four adults, and is capable of going anywhere where roads are provided. So satisfactory has the chassis of this car proved that the makers have found it unnecessary to make any departures from last year's model. The engine has four cylinders, 68 mm. bore by 120 mm. stroke, or a total capacity of 1743 c.cm., the R.A.C. rating being only 11.4 horse-power. This engine's chief feature is the overhead inlet valves contained in a detachable cylinder head, the exhaust valves being of the usual side-by-side type. Four forward speeds, with ratios varying from 15.33–1 to 4.33–1 are provided. The final transmission is by means of spiral bevel gearing. The Humber is only one of a large number of somewhat similar types of car.

Before leaving the subject of coachwork, we should not omit reference to a new system of construction called the Weymann, which is being adopted by several firms of builders. This is of the fabric type, very light in weight, inexpensive and flexible. In the Weymann body, instead of the framework being built up of struts mortised or otherwise held together, the framework consists of wooden members which are flexibly secured together so as to permit of

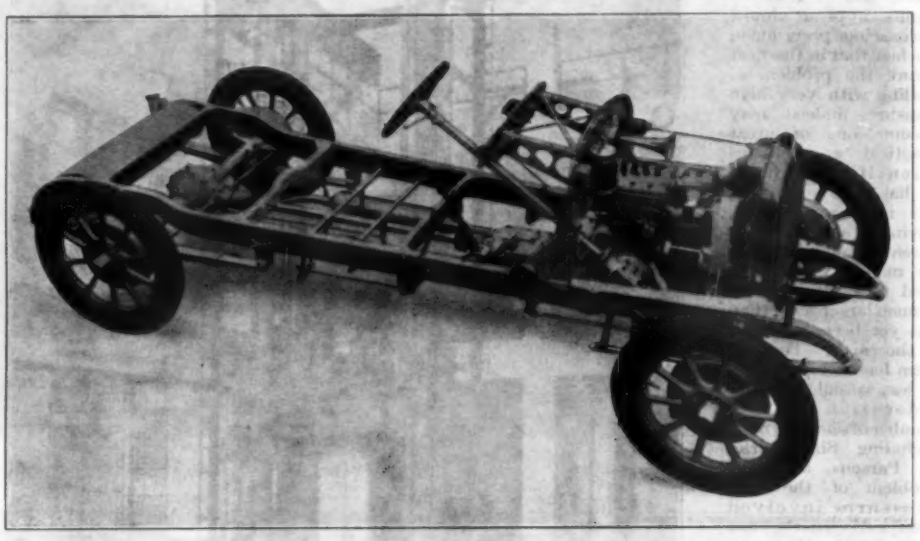


FIG. 8—CHASSIS OF 14 H.P. BEAN CAR

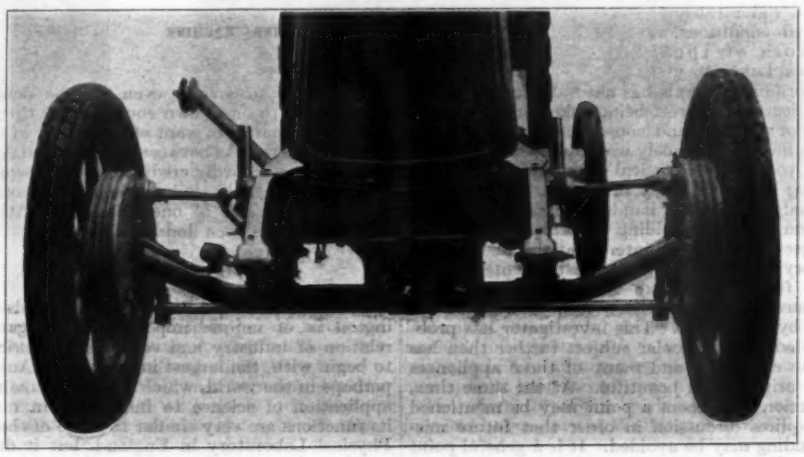


FIG. 9—FRONT VIEW OF 14 H.P. BEAN CHASSIS, SHOWING BRAKES

* No. I. appeared November 2nd.

relative independent movement. The joints are made by steel plates with a space between them, so that they do not rub, and since they do not touch each other, there is no noise due to friction. No metal panels are used, and, instead of them, the wooden frame is clothed with tightly stretched coloured leather fabric. We were not very greatly impressed with the appearance of these bodies, as they do not present the usual high finish of wood or metal, and it will be interesting to observe whether the fabric will stand up against the vagaries of the British climate. If it answers in this respect it may be extensively used for the cheaper makes of cars.

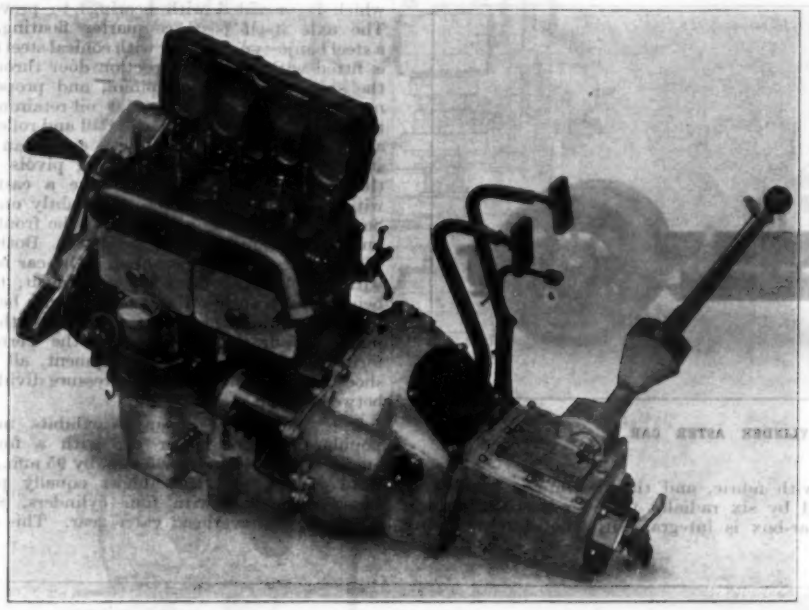


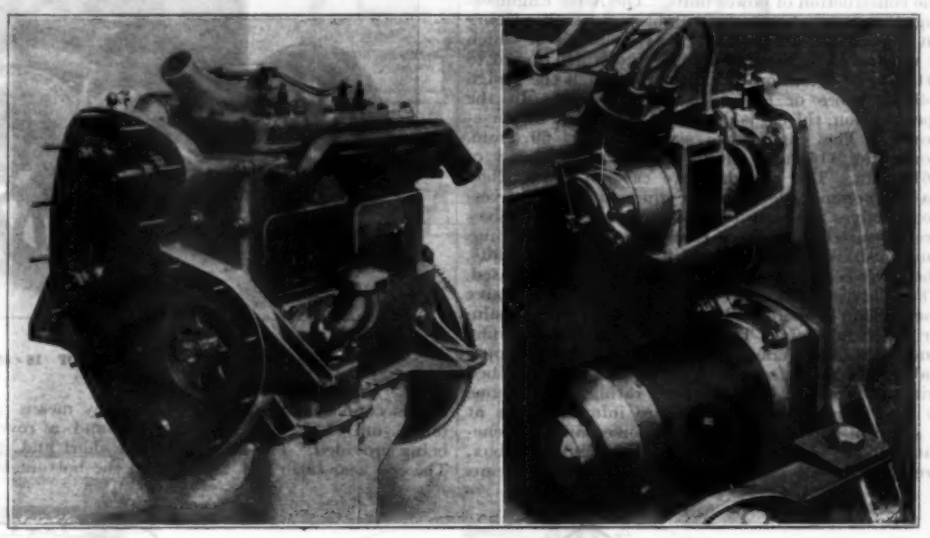
FIG. 10—ENGINE, GEAR-BOX AND CLUTCH UNIT OF 14 H.P. BEAN CAR

Most of the 140 exhibitors of cars find it necessary for production purposes to confine their operations to two or, at most, three sizes of car, and quite 50 per cent. of the cars shown have engines not exceeding 14 horse-power. But there are several noteworthy exceptions to this statement, such, for instance, as the associated B.S.A. and Daimler companies and the Wolseley Company. The former advertise the fact that they can supply 57 different models, from 10 to 45 horse-power, and all with the exception of the smallest have sleeve-valve engines. On the other hand, the firm of Morris confines its operations to cars of only two different powers, viz., 11.9 and 13.9 horse-power, the output of which amounting, we are informed, to 50,000 cars has already been bespoken by its agents. This firm is quite the most formidable rival to Ford. By the most efficient methods of production it is able to manufacture really high-class cars at prices which come within the scope of the buyer of moderate means.

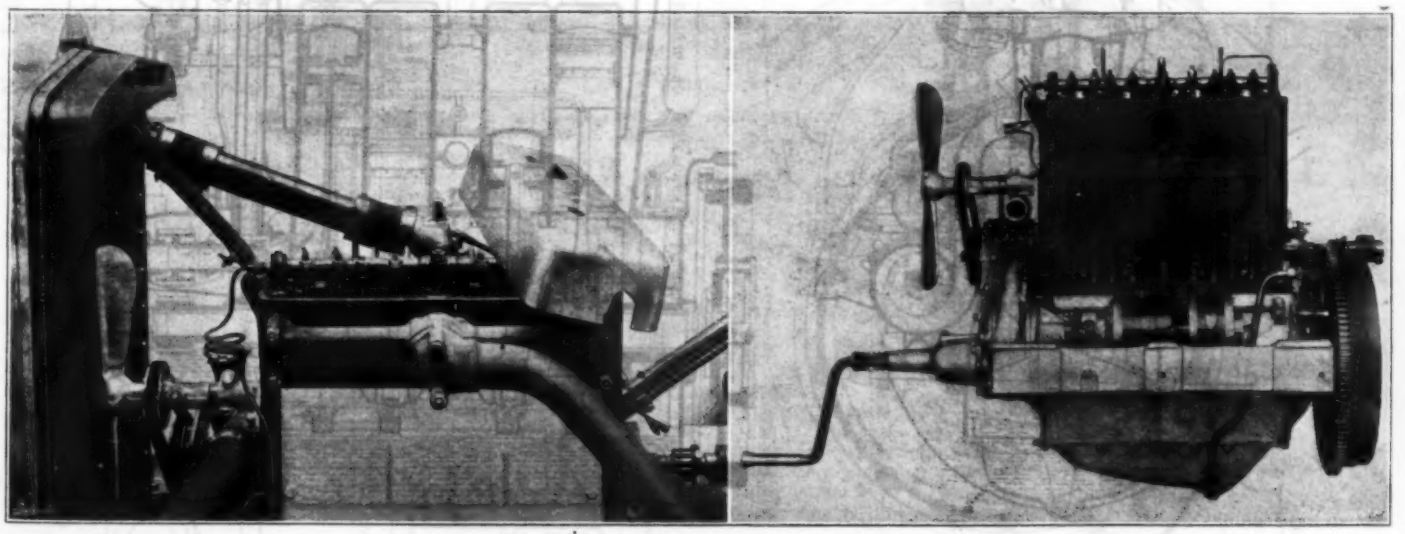
At the other end of the scale, Rolls-Royce and Lanchester, amongst British builders, have the field largely to themselves. These firms each confine themselves to cars of two different powers and of superlative excellence.

A new-comer amongst the less expensive cars which impressed us very favourably is the 14 horse-power Bean—Figs. 8 and 9—made by A. Harper, Sons and Bean, Limited, Dudley. In both design and construction the 14 horse-power chassis is a great advance over this firm's previous machines, and represents wonderful value even in these days of keen competition. The engine, which is illustrated in Figs. 10, 11 and 12, is of the four-cylinder monobloc pattern, with a detachable head, its chief dimensions being 75 mm. bore by 135 mm. stroke, and 2385 c.cm. capacity. It is of unit construction, with the fly-wheel and clutch housing and the gear-box in one, while the valves are of the side by side type, operated by a three-bearing crank shaft; the valves are interchangeable. The cam shaft is operated from the crank shaft by an adjustable silent chain, which also drives a sprocket on the end of the dynamo shaft. A second and smaller sprocket on the latter serves to drive the fan and magneto, a Herner coupling being provided for adjusting the timing of the magneto, while for regulating the tension on this chain the magneto is carried in a cradle secured by studs and slots to permit of movement. The induction manifold is integral with the cyllinder block and is water-jacketed. The crank shaft is carried in three bearings, and is balanced. The engine is lubricated under pressure by a gear-wheel pump, driven by spiral gears from the cam shaft. The pump is enclosed in a filter in the sump which forms the lower half of the crank case and delivers oil through the hollow crank shaft to the main and big end bearings and cam shaft, the oil pressure being adjustable by a regulator valve. Superfluous oil from this valve is fed direct to the timing chain and then drains back to the sump. The Delco-Remy coil ignition system can be fitted in addition, if desired. The gear-box provides four forward road speeds and a reverse, the power being transmitted to the axle by a tubular propeller shaft fitted at either end with a universal joint of the sliding block type. The clutch consists of five steel plates, three of which are covered with Ferodo and run dry. There is an adjustable spring-loaded clutch brake fitted to ensure silent gear changing. The final transmission is by spiral gears of substantial dimensions, and the differential is of the bevel type. The rear axle is of the three-quarter floating type, the wheel hubs being carried on large ball journal bearings. The car is fitted with four brakes on the Perrot system, and the view of the front of the car on page 496, shows that the axle has been specially designed to withstand the stresses imposed by front wheel brakes. The engine is capable of developing over 40 horse-power on the brake.

One of the most popular cars on the market for the owner-driver is the Standard. The Standard Motor Company confines itself to two powers, namely, 11 horse-power and 14 horse-power, and on these chassis numerous bodies are fitted. Illustrations of the 14 horse-power two-seater car and engine are



FIGS. 11 AND 12—TIMING DRIVE AND MAGNETO AND DYNAMO OF 14 H.P. BEAN CAR



FIGS. 13 AND 14—VALVE MECHANISM AND ENGINE OF 14 H.P. STANDARD CAR

given in Fig. 21, page 506, and in Figs. 13 and 14. The company is also making a special feature of a roomy saloon car at a remarkably low price considering the workmanship and finish. A special factory has been erected at Coventry for building these bodies. The 14 horse-power model for 1924 has a positively driven dynamo, overhead valves, magneto ignition and worm drive. The engine has four cylinders, each 75 mm. bore by 110 mm. stroke, the R.A.C. rating being 13.9 horse-power. The gear-box provides four speeds and a reverse. The 11 horse-power car has a four-cylinder engine, 68 mm. bore by 90 mm. stroke, and the R.A.C. rating is 11.4 horse-power.

The name "Aster" is nearly as familiar as that of "Daimler" and "de Dion" in the motor car world, but until recently it has been associated with the construction of power units. The Aster Engineering Company, Limited, Wembley, is now placing on the market a complete car, the chassis of which is illustrated in Figs. 15 and 16, and which is sure to attract the attention of experts, although the design follows, more or less, well proved lines. In the specification, the car is described as of 18 to 50 horse-power. The engine has six cylinders, 69.5 mm. bore and 115 mm. stroke, giving a capacity of 2616 c.cm. The cylinders are cast *en bloc*. They have a common detachable cylinder head and overhead valves fitted with dual springs. The valves are operated by rockers running on roller bearings and push rods provided with oil-cushioned joints, the whole being enclosed and automatically lubricated. The valves are interchangeable, and the valve mechanism is operated by an adjustable silent chain-driven cam shaft. The pistons are of aluminium, and the balanced crank shaft is supported in the upper half of the crank case by four bronze bearings lined with white metal. The Treasury rating of the engine is 17.9 horse-power, but we are informed that at a speed of 2400 revolutions, 50 horse-power is generated. The engine, clutch housing and gear-box, are built as one unit. The lubrication is by means of a detachable gear wheel pump, which is always submerged and surrounded by a detachable filter. The crank shaft is drilled, and all the bearings are lubricated under pressure, including the crank shaft, chain drive, overhead valve gear and clutch spigot.

The clutch is of the single plate type, of aluminium, faced with fabric, and the pressure is evenly distributed by six radially placed adjustable springs. The gear-box is integral with the clutch housing, and is connected to the clutch shaft by means of a fabric universal joint, four speeds and a reverse being provided. The gear shafts are short and stiff. The top gear ratio is 4.2 to 1, and the bottom 16.8 to 1. All the gears are profile ground to ensure quiet operation. The drive from the gear-box is transmitted to the propeller shaft by means of a universal joint of the ring and pin type, completely enclosed in the torque ball and automatically lubricated. The torque ball is mounted on the rear of the gear-box and terminates the torque tube, which is of mild steel and encloses the propeller shaft, which is provided with bearings to prevent whip. The axle itself is three-quarter floating. It has a steel banjo-type housing with conical steel tubes, and is fitted with a large inspection door through which the spiral bevel wheel, pinion and propeller shaft may be withdrawn. Special oil-retaining devices to prevent leakage are fitted. Ball and roller bearings are used throughout. The front axle is an H section steel stamping, and the steering pivots have ball thrust bearings designed to give a castor action without having to lift the car slightly on full lock. Semi-elliptic springs are fitted at the front and long underslung cantilevers at the back. Both foot and hand brakes are compensated. The car is provided with the B.L.I.C. electrical equipment, the starter being totally enclosed and the dynamo being driven from the timing wheel case in tandem with the water pump. Four wheel brakes on the Perrot system form a part of the car's equipment, all the brake shoes being balanced and the pressure divided equally between them.

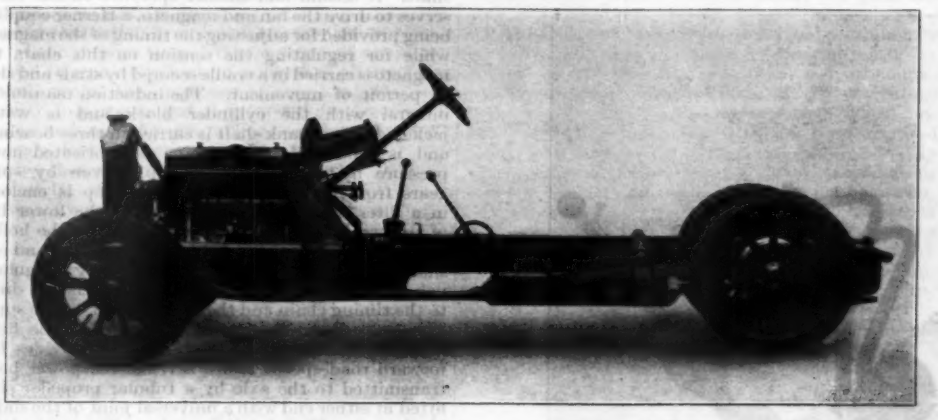


FIG. 15—CHASSIS OF 18-50 H.P. SIX CYLINDER ASTER CAR

The Wolseley Company's exhibits include the popular 10 horse-power car with a four-cylinder engine having cylinders 65 mm. by 95 mm., and overhead valves, and the almost equally popular 15 horse-power car, with four cylinders, 80 mm. by 130 mm., and overhead valve gear. This engine has a thermostatic control for the cooling water. The 15 horse-power car, in its 1924 form, contains numerous alterations and improvements. Sectional views of the engine, clutch, gear-box and back axle are given in Fig. 17, and on page 499. The four-cylinder engine—Fig. 17—has a detachable head and overhead valves operated by an overhead cam shaft.

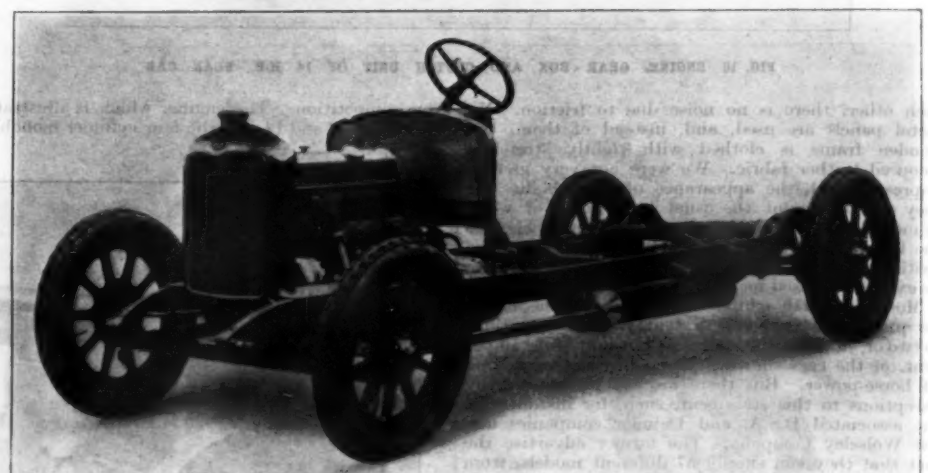


FIG. 16—CHASSIS OF 18-50 H.P. ASTER SIX-CYLINDER CAR

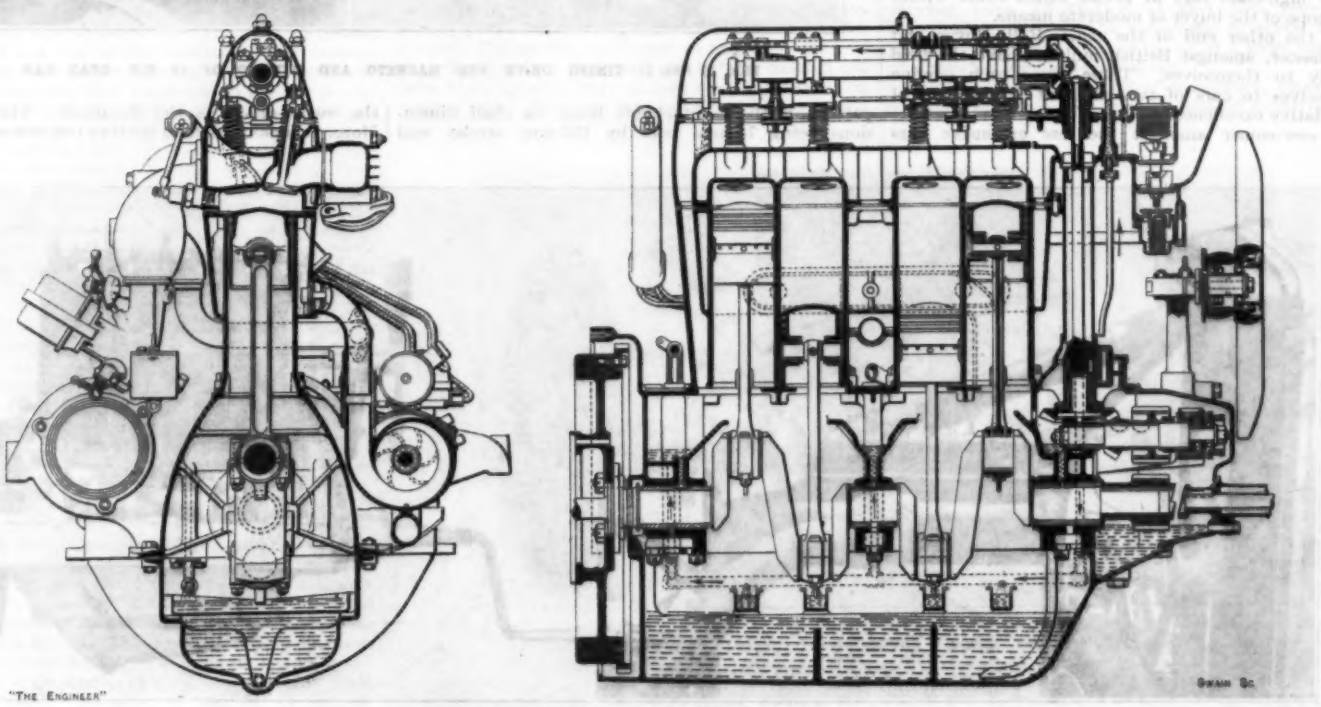


FIG. 17—ENGINE OF 15 H.P. WOLSELEY CAR

CONSTRUCTIONAL DETAILS OF 15 H.P. WOLSELEY CAR.

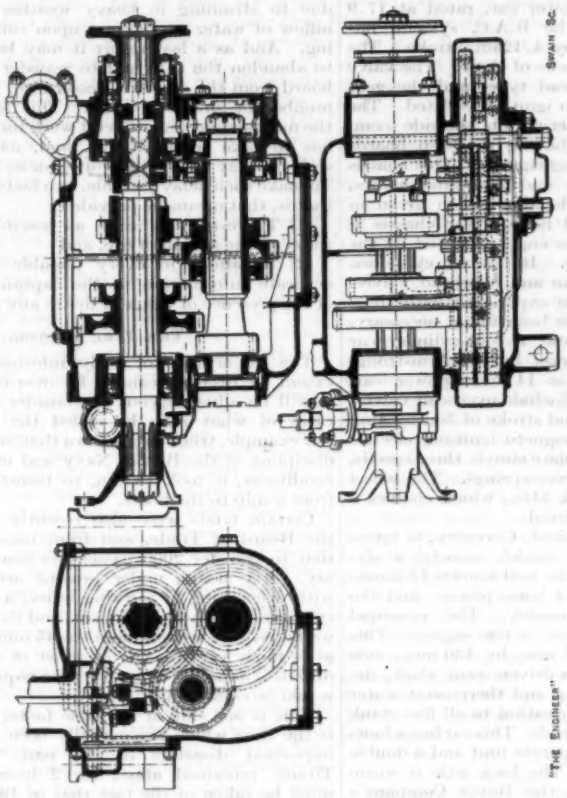


FIG. 19—GEAR BOX

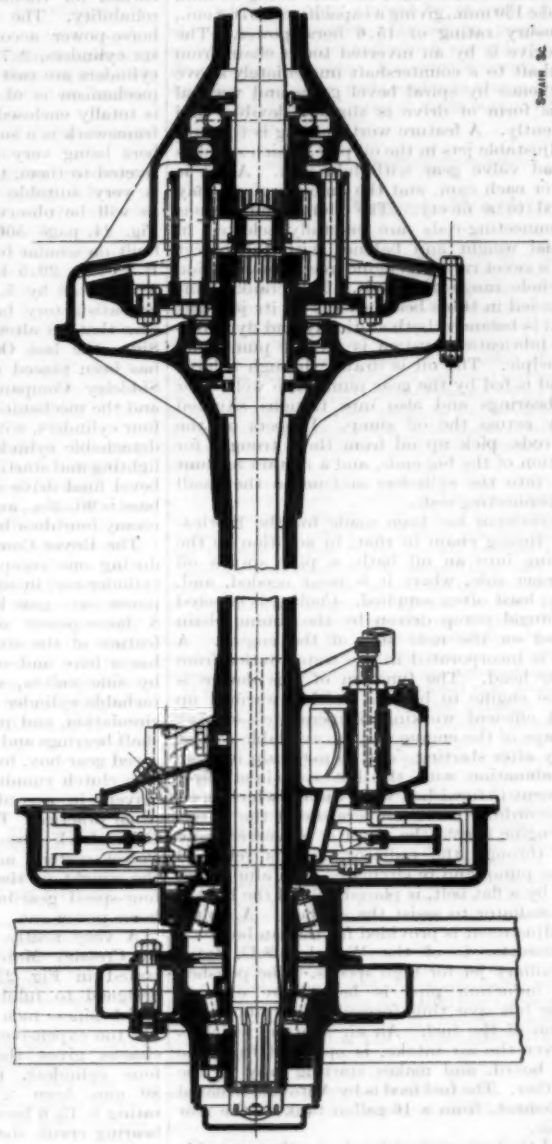


FIG. 20—ARRANGEMENT OF BACK AXLE

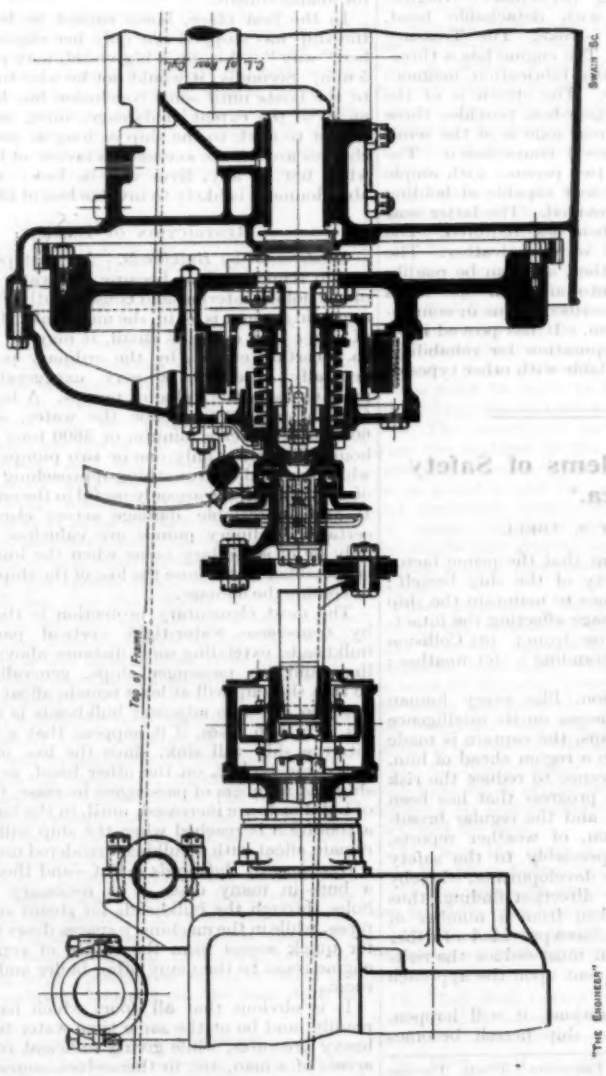
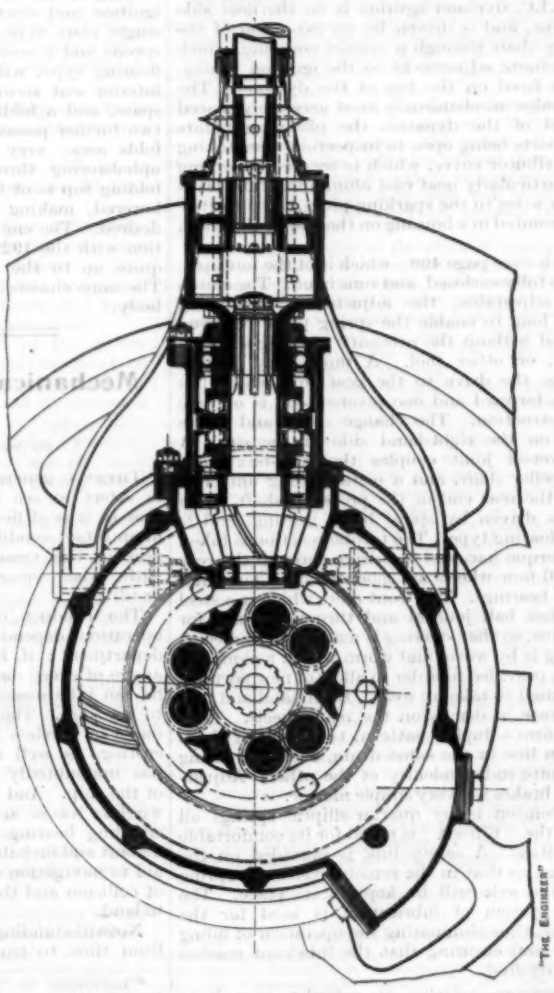


FIG. 18—ARRANGEMENT OF CLUTCH MECHANISM



The cylinders are cast *en bloc*, the bore being 80 mm. and the stroke 130 mm., giving a capacity of 2576 c.cm., and a Treasury rating of 15.6 horse-power. The cam shaft drive is by an inverted tooth chain from the crank shaft to a countershaft immediately above and from thence by spiral bevel gears and vertical shaft. This form of drive is slightly flexible, and operates silently. A feature worth noting is the provision of adjustable jets in the oil pipe, which supplies the overhead valve gear with lubricant. A jet is situated over each cam, and the amount of oil may be regulated to a nicety. The aluminium pistons and the connecting-rods are carefully selected in sets of equal weight and balance with the object of ensuring a sweet running engine free from vibration over the whole range of speeds. The crank shaft, which is carried in three bearings has all its journals ground, and is balanced both statically and dynamically. The lubrication system is on the pump and trough principle. The oil is drawn through a large strainer, and is fed by the gear pump into wells over the main bearings and also into troughs situated transversely across the oil sump. Dippers on the connecting-rods pick up oil from these troughs for the lubrication of the big ends, and a certain amount is splashed into the cylinders and on to the small ends of the connecting-rods.

Special provision has been made for the lubrication of the timing chain in that, in addition to the chain dipping into an oil bath, a pipe sprays oil on to its inner side, where it is most needed, and, incidentally, least often supplied. Cooling is effected by a centrifugal pump driven by the timing chain and situated on the near side of the engine. A thermostat is incorporated in the water outlet from the cylinder head. The function of this device is to cause the engine to become quickly warmed up to its most efficient working temperature—so that the full power of the engine may be available almost immediately after starting—and to maintain it there and in combination with the hot spot inlet pipe. The instrument is furnished with valves, which open and close according to the temperature of the water. When the engine is cold the water is prevented from circulating through the radiator, and is returned direct to the pump and re-circulates. An aluminium fan, driven by a flat belt, is placed behind the honeycomb type radiator to assist the air flow. A simple excentric adjustment is provided for the fan bolt.

The carburetter is of the Wolseley S.U. type, with an auxiliary jet for high speeds. The polished aluminium induction pipe is heated by exhaust gas, and the hot spot thus formed brings about the evaporisation of the fuel. An air shutter, which is arranged over the air intake, is operated from the instrument board, and makes starting easy in the coldest weather. The fuel feed is by Autovac, situated under the bonnet, from a 16-gallon tank at the rear of the chassis.

The B.L.I.C. dynamo ignition is on the near side of the engine, and is driven by an extension of the water pump shaft through a vernier coupling, which allows of minute adjustment to the ignition timing. The coil is fixed on the top of the dynamo. The contact breaker mechanism is most accessibly placed on the end of the dynamo, the platinum points and other parts being open to inspection after taking off the distributor cover, which is secured by spring clips. A particularly neat cast aluminium tube leads the ignition wires to the sparking plugs. The electric starter is mounted in a housing on the rear of the crank case.

The clutch—see page 499—which is of the multiple-disc type, is fully enclosed, and runs in oil. The clutch spring is adjustable, the adjustment nut being sufficiently long to enable the spring to be removed and replaced without the necessity of using a spring compressor, or other tool. A universally jointed shaft carries the drive to the gear-box, which has four speeds forward and one reverse, and is of very robust construction. The change speed and brake levers are on the right-hand side of the car. A fabric universal joint couples the gear-box shaft to the propeller shaft, and a metal sliding universal joint is at the rear end of the propeller shaft. The rear axle is driven by spiral bevel gearing, and is of the full-floating type. The torque reaction is taken by a stiff torque bar, and the drive through the rear springs. All four wheels are mounted on "Timken" taper roller bearings. The front axle, which is a steel stamping, has ball journal and thrust bearings for the pivot pins, so that steering is made light and easy. The steering is by worm and worm wheel, a complete wheel being provided in order to allow of new portions of it being used to take up wear. Both hand and foot brakes operate in drums on the rear wheels. They are of the firm's duplex pattern, two pairs of shoes operating in line in the same drum, each pair being actuated quite independently of the other. Adjustment of the brakes is a very simple matter.

The suspension is by quarter-elliptic springs all round, and the "Fifteen" is noted for its comfortable riding qualities. A safety link is provided on the front springs, so that in the remote event of a spring breakage, the axle will be kept in its place. The grease-gun system of lubrication is used for the chassis parts, thus eliminating the operation of filling grease-cups and ensuring that the lubricant reaches the points required.

The Armstrong-Siddeley six-cylinder cars have earned for themselves a very high reputation for reliability. The 18 horse-power car, rated at 17.9 horse-power according to the R.A.C. system, has six cylinders, 2.73in. bore by 4.125in. stroke. The cylinders are cast in two blocks of three. The valve mechanism is of the overhead type, and the gear is totally enclosed. Magneto ignition is fitted. The framework is a sound engineering job, the side members being very deep and having the step boards riveted to them, thus ensuring rigidity. This chassis is very suitable for saloon and limousine bodies, as will be observed from the illustration given in Fig. 24, page 506. The 30 horse-power chassis is built on similar lines, but the engine is rated by the R.A.C. at 29.5 horse-power. It has six cylinders, 3.5in. bore by 5.25in. stroke and overhead valves. So satisfactory has been the experience with these cars that no alterations have been found necessary. Since the last Olympia Show, a four-cylinder car has been placed on the market by the Armstrong-Siddeley Company. It is a 14 horse-power car, and the mechanical features include overhead valves, four cylinders, with a bore and stroke of 3in. by 4in., detachable cylinder head, magneto ignition, electric lighting and starting, single-plate clutch, three speeds, bevel final drive and cantilever springs. The wheel base is 9ft. 3in., and the track 54in., which enables a roomy four-door body to be fitted.

The Rover Company, Limited, Coventry, is introducing one completely new model, namely, a six-cylinder car, in addition to the well-known 12 horse-power car—now known as 14 horse-power—and the 8 horse-power air-cooled model. The principal feature of the six-cylinder car is the engine. This has a bore and stroke of 75 mm. by 130 mm., side by side valves, silent chain-driven cam shaft, detachable cylinder head, pump and thermostat water circulation, and pressure lubrication to all five crank shaft bearings and to the big ends. This car has a four-speed gear-box, forming a separate unit and a double disc clutch running in oil. The back axle is worm driven, in accordance with the Rover Company's usual practice. The chassis has half-elliptic springs, D.N. shock absorbers, four wheel brakes on the Perrot system, and with a Weymann saloon body the weight of the car complete is only 26 cwt. A four-speed gear-box is now being fitted to the 14 horse-power car.

A very neatly designed two-seater Coupé built by Crossley Motors, Limited, Manchester, is illustrated in Fig. 22, page 506. This car has been designed to fulfil the requirements of professional and business men who need a neat, comfortable and not too expensive carriage. The specification of the chassis gives the following particulars:—Engine, four cylinders, monobloc with detachable head, 80 mm. bore × 120 mm. stroke. The Treasury rating is 15.6 horse-power. The engine has a three-bearing crank shaft, automatic lubrication, magneto ignition and electric starter. The clutch is of the single plate type, and the gear-box provides three speeds and a reverse. The rear axle is of the semi-floating type, with spiral bevel transmission. The interior seat accommodates two persons with ample space, and a folding dickey seat capable of holding two further passengers is provided. The latter seat folds away very neatly when not required. The upholstering throughout is of real leather. The folding top is of flexible leather, and can be readily lowered, making the car into an open one when desired. The engine was described by us in connection with the 1922 Exhibition. It has proved itself quite up to the makers' reputation for reliability. The same chassis is also available with other types of body.

Mechanical Problems of Safety at Sea.*

By Sir WESTCOTT S. ABELL.

THERE is general agreement that the prime factor in safety at sea is the safety of the ship herself; that is, it is of first importance to maintain the ship in an intact condition. Damage affecting the intactness of the vessel may arise from: (*a*) Collision with other vessels; (*b*) stranding; (*c*) weather; or (*d*) fire.

The conduct of navigation, like every human operation, depends for its success on its intelligence department; if, by any means, the captain is made aware of every danger within a region ahead of him, he can take measures in advance to reduce the risk to the ship. The enormous progress that has been made in wireless telegraphy and the regular broadcasting, as well as collection, of weather reports, has undoubtedly added appreciably to the safety of the ship. And the further developments, whereby wireless waves are used for direction finding, thus enabling bearings to be taken from a number of distant and invisible beacons, have provided a further aid to navigation which again must reduce the risks of collision and those consequent upon the approach to land.

Notwithstanding all precautions, it will happen, from time to time, that the ship herself becomes damaged—it may be from fire within, from leakage due to straining in heavy weather, or by serious inflow of water consequent upon collision or stranding. And as a last resort it may become necessary to abandon the ship and to transfer all the lives on board from the disabled vessel into, perhaps, a large number of small lifeboats. This last operation is the most serious and difficult work for which a captain has to take responsibility, and, naturally, he will seek to delay such a difficult task as long as possible. To make such delay possible, two factors are essential; that is, that means be provided:

(1) To restrict as much as possible the inflow of water or the spread of fire, and

(2) To afford in every possible way rapid and accurate information to the captain on the bridge of the presence of water or fire in any part of the ship.

The Time Factor.

The importance of early information as to the extent of disaster cannot be over-emphasised, and it will be advantageous to consider some particular cases of what may be called the "time factor." For example, trials have shown that, with the excellent discipline of the British Navy and under favourable conditions, it took 16 min. to transfer 1000 seamen from a ship to the boats.

Certain trials were also recently carried out for the Board of Trade, and from these it is deduced that to transfer 2000 passengers from the ship into, say, forty boats, under present arrangements and with everything in working order, a well-disciplined crew, fine weather, a calm sea, and the vessel upright, would require from 30 min. to 45 min. If, therefore, as is fairly certain, one or other of these ideal conditions is departed from, the time required for transfer would be considerably longer.

This is one side of the time factor; the other side is the time which has actually been available in the important disasters of the past. Although the Titanic remained afloat for 2 hours, yet account must be taken of the fact that in 1914 the Empress of Ireland sank in 20 min., as did also the Egypt in 1922, to say nothing of the Lusitania, the damage to which was, however, of an unusual character arising from war operations. It may, of course, be argued that these are extreme examples, but it must be remembered that emergency conditions are very exacting, and it would be fair to say that when casualties occur which involve abandoning the ship, the time available is likely to be rather of the nature of 30 min. than 60 min. In the very essence of things quite an appreciable time must elapse between the casualty and the giving of orders for abandonment.

In the first place, boats cannot be lowered until the ship has stopped not only her engines, but also her "way"—this, on a big vessel, may perhaps take 5 min. Secondly, it would not be wise to give orders to the boats until some conclusion has been arrived at as to the extent of damage, since, in general, it is best to stick to the ship as long as possible. The chances are, on the average, in favour of her survival, when few, if any, lives will be lost; whereas the abandonment is likely to involve loss of life.

Restriction of Damage.

Subdivision by Bulkheads.—As most people know, a ship remains afloat because the water is kept out of the hollow interior, and consequently, if more than a certain amount is let in, she must sink. If the amount of water that enters is small, it may be kept under, to a certain extent, by the ordinary pumps; but, generally speaking, a very exaggerated opinion prevails as to the value of pumps. A hole 1 square foot in area, 25ft. below the water, admits over 60 tons of water a minute, or 3600 tons of water an hour. There are only one or two pumps in the ship which can deal with anything approaching this amount of water, and these are only useful in the engine-rooms. If any appreciable damage occurs elsewhere then certainly ordinary pumps are valueless. They can only be of secondary value when the initial damage is not sufficient to cause the loss of the ship, by helping to confine the damage.

The most elementary protection is that provided by transverse water-tight vertical partitions, or bulkheads, extending some distance above the water-line, and, in passenger ships, generally arranged so that the ship will at least remain afloat if the space between any two adjacent bulkheads is open to the sea. In such cases, if it happens that a bulkhead is hit, the ship will sink, since the loss of buoyancy is too much; but, on the other hand, as the size of ship and numbers of passengers increase, the numbers of bulkheads are increased, until, in the larger vessels, a condition is reached when the ship will more than remain afloat with a bulkhead rendered useless.

Openings in Bulkheads.—But—and there is always a but—in many cases it is necessary to provide holes through the bulkheads for steam and drainage pipes, while in the machinery spaces doors are required for quick access from the centre of control in the engine-room to the many other boiler and machinery rooms.

It is obvious that all doors which have to open readily, and be at the same time water-tight against heavy pressures, while giving sufficient room for the access of a man, are, in themselves, sources of weakness. It is almost axiomatic that the most satis-

* Institution of Mechanical Engineers.—Tenth Thomas Hawksley Lecture (abstract).

factory doors are no doors. But, as doors are necessary, it is, in the first place, imperative to make their number as small as possible, and secondly, to provide mechanical and power means by which, when in danger, these doors can be shut rapidly and effectively from a central station or from the bridge. Much research and investigation has been given to this question, and there are various systems now in operation which not only provide the necessary central control, but also allow the door to be opened and shut locally.

Openings in Sides of Vessels.—Another factor that must not be lost sight of is the risks that arise from smaller openings in the sides of ships, as well as in the divisional bulkheads. In view of the developments which have been made in ship ventilation, it should at least be possible to require that below the bulkhead deck the sidelights should be fixed; that is, not capable of being opened. Where, however, movable sidelights are necessary, they should, if possible, be capable of being closed quickly and effectively from some one or more control stations. The question of what may be termed sanitary openings is also worthy of consideration. Such drains are generally provided with a non-return clack valve at the side when they are below or in the region of the water-line; but it has not been considered a satisfactory provision against leakage, and the regulations require a second valve to be fitted, which is either itself always accessible, or is operated by gearing which is always accessible. It will, perhaps, be recognised that some form of centralisation treatment would be effective in reducing the number of side openings, say, by grouping the decks into sections, draining all such sections into one system, and discharging through one large opening.

Internal Drainage.—While on this question of restriction of access of water, attention should also be called to the arrangements by which water in the double bottoms and lower parts of the holds is taken out by the pumps in the machinery rooms. Pipes are led direct from the spaces to an engine or boiler-room, passing through the water-tight bulkheads. If one of these pipes is damaged somewhere between the pump and the suction end, and water has access to the space where the pipe is broken, then water will also pass to the hold where the suction pipe ends, destroying the integrity of the intervening bulkhead. Cases of this nature occurred during the war, from torpedo damage, and automatic valves were introduced which would prevent such backflow. But one of the troubles with drainage from cargo holds is the liability of the pipes becoming choked by the cargo itself, if of grain, or, in any case, by rubbish coming from the cargo or its packings.

Restriction of Fire.—The methods for dealing with restriction of fire on board ship have not been subjected to the same close attention as has been given to subdivision, but in passenger vessels fire-doors and partitions are now fitted, to localise damage and safeguard the question of access and exits, while, of course, from the many pumps existing on shipboard there is an adequate supply of mains and water for extinction purposes.

Abandonment of Ship.

Reference has already been made to the seriousness of this operation, and stress laid upon the desirability of affording the captain accurate and immediate information of the extent of the damage to the ship. But as this vexed question has been much discussed, it will be of help to examine the position critically, and for the purpose of the argument to consider an extreme case. In the first place, it may be taken that the disaster occurs at night and the damage is such that the main dynamos in the machinery rooms are placed out of action. The ship is being stopped, and the emergency oil-driven dynamos situated well above water are started, connections being made to the lighting circuits throughout the ship as far as they can be operated; it is presumed automatic cut-outs will take account of short circuits arising from damaged cables. Then, all being well, the special lights on the boat deck are connected up, the searchlights for assistance in boat lowering switched on, and the power circuits to boat-operating winches connected up. All of this takes time, but ample light is of extreme importance in the need to wake and marshal passengers to stations well above the water-line.

The seamen and other crew man the boats, these being first turned out—perhaps, as likely as not, there is a list, and on that account there is a difficulty with the boats on that side, making them more difficult to turn out. Probably, in the big vessels, the boats are too deep, and care has to be taken to get away the first boat to the deck below the boat deck, so that passengers can embark, while at the same time all the attachments of the second boat must be kept clear, because directly the first is clear of the ship's side the second must be lowered.

In addition, there may be a rough sea, the vessel is rolling, the boats swinging from long ropes—it is often in the large vessels over 60ft., or twice the height of an ordinary house, from the boat deck to the water.

Boat Lowering Arrangements.

The physical problem to be solved is really divided into three groups of cases:—

(*a*) Vessels in which all the lives on board can be accommodated in one tier of boats, all attached to davits on the side of the ship.

(*b*) Vessels in which more than one boat is attached to a pair of davits up to the limit when each set of davits on the ship's side has to operate two boats; and

(*c*) Vessels in which the number of lives require more than two boats to a pair of davits.

An analysis of existing foreign-going passenger vessels made by the Merchant Shipping Advisory Committee showed that 66 per cent. of the vessels fall under Class A, 20 per cent. in Class B, and only 14 per cent. in Class C. This Committee also concluded that, while power might perhaps reasonably be used in launching boats, main reliance must be placed on man-handling, and that as many sets of davits as possible should be carried on the ship's sides. Its opinion was that not more than two lifeboats should be stowed adjacent to each pair of davits. Any boats required in excess of this number should be carried in positions well away from the boats near the davits.

It recognised the complexity in boat lowering caused by the heeling of the vessel, and considered the outer lifeboats should be carried swung out, or with the keels in line with the deck edge, so that the boats could be launched overboard without lifting. The Committee also pointed out the necessity to provide for another contingency, which was also indicated by experience, namely, that in any casualty in which abandonment of ship was necessary, there would always be some people in the water, and there should be some floating apparatus, light and buoyant, to support them in the water. It may, perhaps, help towards an understanding of the problem if an approximate time-table be given showing how the 30 min. available can be used to the best advantage:—

Time-table.

	hr.	min.	
Zero hour ..	0	00	Casualty occurs. Ship's engines stopped.
	0	5	Alarm given. Ship stopped. Crew to boat stations. Passengers warned.
	0	10	Light rafts thrown overboard. Boats turned out ready for loading.
	0	20	First line of boats loaded and lowered to water. Falls for second line of boats attached to davits and second line of boats begin loading.
	0	30	Second line of boats in water.
Ship sinks.			

Any of the second line of boats which are not likely to be safely launched, and all other boats, should be released from their attachments to the ship in the last 10 min. Perhaps it would be as well, preferably at 20 min. after the casualty, to see that all boat lashings are severed.

From this subjective analysis of requirements it should be comparatively simple to lay down a basis of requirements for boats' davits, somewhat as follows:—

(1) Davits should be capable of taking two boats together, each boat having separate attachments for the lowering ropes at each davit.

(2) The davits should be able to put both boats over the side at once against a list of at least 10 deg., and perhaps as much as 15 deg.

(3) The lowering ropes should be kept separately, and bitts provided for each rope, so that two men can control the lowering of each end of a boat.

(4) As it is preferable to stow boats outboard, means must be made to bring the davits and boats inboard rapidly for harbour and quay purposes.

(5) The control of the movement of the davits from the harbour to the lowering position must be extremely simple—gearing should be avoided as far as possible, and any gearing should be shrouded and protected from accumulations of paint, dirt, ice, water, or other foreign substances. Further, the simpler the gearing the more often and the more readily will all concerned work for its proper maintenance.

There remain to be mentioned the physical requirements considered necessary for the rafts, or light buoyant apparatus, which, according to the suggested time-table, should be thrown overboard as soon as the ship herself has stopped and before the boats are lowered. The specification given by the Merchant Shipping Advisory Committee may, perhaps, be quoted with advantage:

(1) All foreign-going vessels shall be equipped with light rafts, or buoyancy apparatus, of sufficient capacity to accommodate 25 per cent. of the lives on board the ship.

(2) These life rafts shall be reversible, *i.e.*, they must be able to float either way up.

(3) The size and weight shall be such that they can be easily man-handled.

(4) The strength shall be sufficient to enable them to be thrown without injury from the deck on which they are stowed.

(5) They shall have a buoyancy or support in the water of 32 lb. for each person, and the main buoyancy shall be provided by air cases at the sides.

(6) They shall be provided with a painter of sufficient length to enable them to be attached to the ship or to the boats.

In addition, they should be of such shape as to be compactly stowed together in positions which are easily accessible, and which are well clear of other life-saving apparatus. Experience seems to indicate that they should be rectangular in shape, and stowed in four solid blocks, one at each corner of the boat deck, or near thereto.†

British Patent Working.

A certain amount of misunderstanding appears to be prevalent at the present time as to the requirements of the British Patent Law on the working of inventions in this country for which patents have been granted. It is a most important matter, because a considerable amount of money may be involved, and is of particular interest to engineers, owing to the fact that in order adequately to work some comparatively small patented matter an expensive machine may need to be constructed. This is apparent when one recollects that owing to the advanced state of the engineering arts patents, of necessity, can only relate to comparatively small features rather than to new broad principles.

The law on working has undergone very material changes in the last ten to twenty years, and that probably accounts for the present difficulty. The Acts to-day deal with the matter of the working of British patents on the basis that patents for new inventions are granted not only to encourage invention but to secure that new inventions shall, so far as possible, be worked on a commercial scale in the United Kingdom without undue delay. This working on a commercial scale means that the manufacture is to be carried out by means of a definite and substantial establishment or organisation and on a scale which is adequate and reasonable in all the circumstances.

If this is not done it is considered that *prima facie* the monopoly rights granted to the patentee have been abused. The remedy provided for any person who has been affected by the monopoly rights being abused or indeed, according to the law presumably for any person at all, is to apply to the Comptroller of Patents for a measure of relief. This may take the form of a non-exclusive licence or the much more important grant of an exclusive licence, or again, the Comptroller may revoke the patent.

The grounds on which application may be made to the Comptroller may be summed up as follows:—

(1) After four years from the date of the patent, if the invention is not being worked in this country on a commercial scale and no satisfactory reason can be given for such non-working.

(2) If working is being hindered by importation from abroad or the demand for the patented article is not being met to an adequate extent and on reasonable terms.

(3) If by reason of the refusal of the patentee to grant licences, trade or industry of persons trading in this country is hampered or the establishment of a new trade prejudiced.

(4) If any trade is unfairly affected by conditions attached by the patentee to his licences.

On proof of any of these grounds the Comptroller may take action.

The first point to notice is that previously no redress could be sought against a patentee who did nothing but merely obtain a patent to prevent others obtaining or using what was covered thereby so long as he did not manufacture abroad. If now the patent is granted for something that can be worked in this country and no commercial working is effected, unless the matter can be suitably explained, relief will be given. Probably in due course there will be reported the results of the Comptroller's actions taken under the present Acts, and they will serve to show what he regards as satisfactory reasons for non-working. It is likely that lack of demand and lack of capital will be important grounds that can be successfully pleaded.

On proof that a case of the abuse of monopoly rights has been established the Comptroller may order the patent to be endorsed with the words "Licences of Right," and thereby make it free for anyone to obtain a licence on reasonable terms, the result being that if licences already exist every such licensee may apply to have the terms of his licence altered to agree with the terms of the new licence should this be less onerous.

Another form of relief is the grant of an ordinary licence. The more important case, however, which marks a considerable advance in legislation, is that if the invention is such that it cannot be worked without expenditure of capital for the raising of which it will be necessary to rely on the patent monopoly, the Comptroller may grant an exclusive licence to any person whom he is satisfied is able and willing to provide the capital.

Revocation of the patent is also permitted by the Comptroller, but such a strong action may only be taken if the Comptroller is satisfied that the objects of the law cannot be obtained by the exercise of the grant of suitable licences.

Should the Comptroller order the grant of a licence it is provided that this grant shall operate as if it were actually embodied in a deed granting a licence, executed by the patentee and all other necessary parties.

This is an epitome of the law as to working as it now stands. Non-working is no longer a legal plea against the validity of a patent, nor may it be pleaded as an argument in favour of a petition to the court for the revocation of a patent. In this respect, therefore, the position stands as it did in the early part of the year 1907, and the changes made subsequently no longer apply.

All orders of the Comptroller under the working clauses of the present law are subject to appeal to the court, and on any such appeal the law officer or such other counsel as he may appoint shall be entitled to appear and be heard.

† The lecture concluded with an interesting kinematograph film illustrating boat drill on the Cunard liner Aquitania. In this case the second line of boats was in the water 25 min. after the "abandon ship" signal. The drill was carried out in harbour under ideal conditions and, except for one boat, without the passengers.

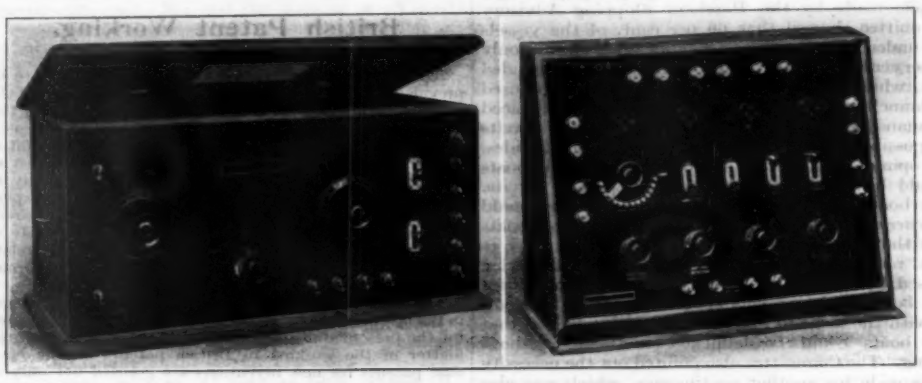
The Wireless Exhibition.

No. I.

THE All-British Wireless Exhibition, which was opened on Thursday last at the White City, is of great interest to wireless enthusiasts and to the public generally. It is a far more extensive show than the Exhibition which was held last year at the Horticultural Hall, where, on account of the inadequate space, visitors were subjected to great discomfort. To those who visited that Exhibition and who found it impossible to see anything properly on account of the crush, it was evident that the next Exhibition would have to be held in a more commodious building. During the last twelve months many more people have become interested in wireless telephony. Aerials have been erected all over the United Kingdom, and even schoolboys now talk learnedly about capacity and inductance.

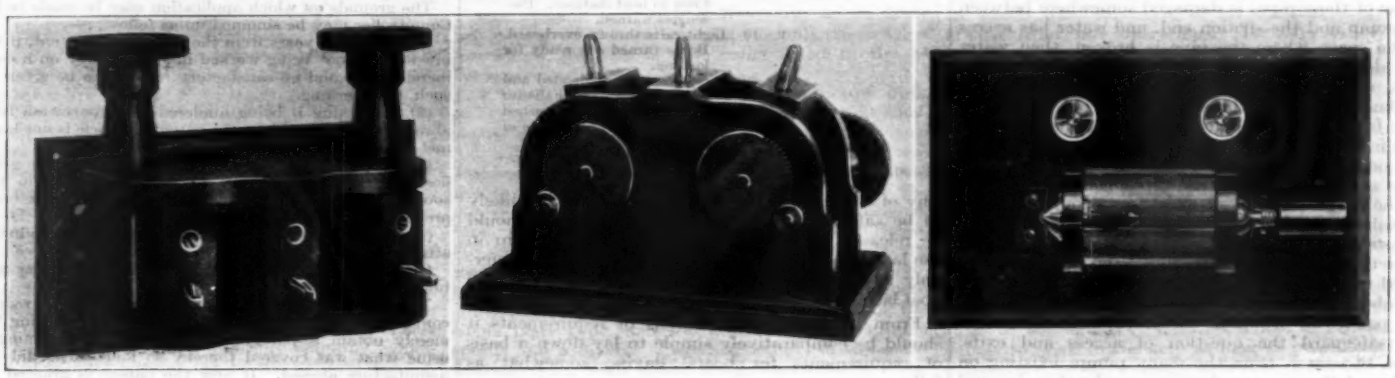
Since the last Exhibition there has also been a considerable increase in the number of wireless manufacturers, and it is to be hoped that the new industry will provide sufficient work to keep them all going. Listening-in is, of course, mainly a winter hobby. When the bright days arrive people naturally seek other forms of amusement, and a falling off in trade is to be expected. In America, where broadcasting stations have been in existence longer than they have been here, this drop in the demand for wireless goods during the summer has been very pronounced. Still there seems to be little doubt that broadcasting has come to stay, and if public interest in it can be maintained, it should help in no small measure to alleviate unemployment. Of course, the progress of the new industry depends, to a great extent, upon those associated with the British Broadcasting Company. If the programmes do not continue to meet with more or less general approval, then the industry will suffer. It must be admitted that those connected with the Broadcasting Company have a difficult job, for public taste with regard to music varies considerably. A very good scheme was, however, referred to by Dr. Eccles at a recent meeting of the Radio Society of Great Britain. In order to give more general satisfaction, Dr. Eccles explained, one of the American broadcasting stations is sending out two transmissions simultaneously, with a difference in wave length of 50 m. In one case high-class music is transmitted, whilst in the lower wave length Jazz and similar music is sent out. This idea seems to us to be a very excellent one, and the scheme should do much towards making broadcasting really popular.

To what extent wireless telephony appeals to the average engineer we do not know. It is certain, though, that engineers in common with others welcome any development that will minimise unemployment. Apart from this, however, wireless communication is of very great interest from a scientific point of view, and those with scientific instincts can scarcely ignore wireless work altogether. At the Exhibition every class of wireless enthusiast is catered for. There are exhibits which appeal to those who are only interested in wireless telephony purely from the point of view of amusement, and also exhibits which will attract the investigator. In view of the fact that the Exhibition was only opened on Thursday, November 8th—the day before the publication of this issue—we cannot go very amply into details in the present article, but the following brief notes on some of the exhibits may nevertheless prove of interest.



FIGS. 1 AND 2—BURNDEPT FOUR-VALVE RECEIVING SETS

The receiving sets shown by Burndept, Limited, are very beautifully finished. The receiver shown in Fig. 1 is the company's well-known "Ethophone V." four-valve receiver, the last valve being a power valve, and the set is provided with a "selector" for use when trouble is experienced from interference from ships' wireless installations, land stations, &c. The valves in these "Ethophone" sets are enclosed in the case, but they can easily be removed. The instruments are designed to give the highest efficiency, but they can be operated with perfect ease. The sets are, of course, suitable for working loud speakers. Another well-known type of receiving set made by Burndept, Limited, and shown at the Exhibition, is illustrated in Fig. 2. The last stage of audio-amplification on this receiver is now also a power stage, and works with a L S5 or L S3 valve. Of course, the use of these valves results in the production of a large volume of sound. At the same time, the makers state, the quality of speech or music is in no way impaired. Besides these and other receiving sets, the company is showing component parts, such as coil holders, crystal detectors, loud speakers, &c. The "Ethovox" loud speakers made by the company are very handsome instruments, and they are claimed to be capable of dealing with a considerable amount of power without producing distortion. A new instrument, recently designed by the company, is the public address unit, which enables anyone possessing a receiving set capable of working a loud speaker to address large audiences. Two views of a coil holder are shown in Figs. 3 and 4. Gearing is employed for shifting the coils, thus ensuring smooth action and enabling fine adjustments to be made. The ratio of the gearing is 5 to 1. Other exhibits of interest are the Burndept crystal detector with micrometer adjustment—see Fig. 5—inter-valve transformers, anti-capacity switches, precision condensers, vernier condensers, &c.



FIGS. 3 AND 4—BURNDEPT COIL HOLDER

FIG. 5—CRYSTAL DETECTOR

The crystal receiving set shown in Fig. 6 is one of the exhibits of the Sterling Telephone and Electric Company. This is a variometer-tuned instrument, which is capable of receiving broadcast telephony within a range of about 30 miles, and also the Paris time signals. The semi-automatic crystal detector fitted to the set permits of rapid adjustment, and as it is totally enclosed oxidation of the contact point and crystal is avoided. The instrument—shown in Fig. 7—is fitted with a dual amplification high and low-frequency valve, and a crystal detector. The valve is of the dull emitter type, and works at a pressure of 1.8 volts. The range of the instrument, when used for broadcast reception, is about 100 miles,

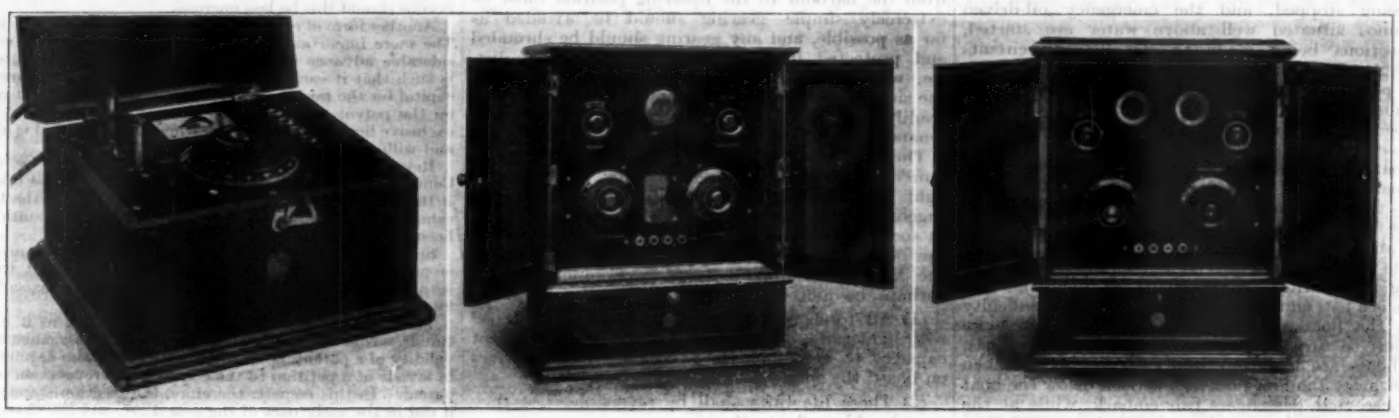


FIG. 6—STERLING CRYSTAL SET

FIG. 7—STERLING SINGLE-VALVE SET

FIG. 8—STERLING TWO-VALVE SET

and the wave length range is about 280 m. to 2800 m. The instrument is equipped with two variometers, a semi-automatic crystal detector, a drum-type switch for controlling the wave length range, and a filament resistance. Another of the Sterling Company's exhibits is the set shown in Fig. 8. This is a two-valve receiving set, and is claimed to be suitable for the reception of broadcast speech or music either from local or distant stations. The first valve is a high-frequency amplifier, and the second valve a detector. The anode circuits are coupled with a reaction unit, which introduces reaction in an effective manner. The set is fitted with a patented metal panel, which prevents hand capacity. The variable condenser for the tuned anode has specially shaped vanes, which gives a uniform wave length variation, and fine tuning is made possible by a vernier adjustment. The aerial circuit is tuned by means of a variometer, and provision is made for inserting plug-in coils, and different anode reaction units suitable for wave lengths other than those of the British broadcasting stations.

Among the exhibits of Siemens Bros., of Woolwich, is a three-valve receiving set, which has been designed

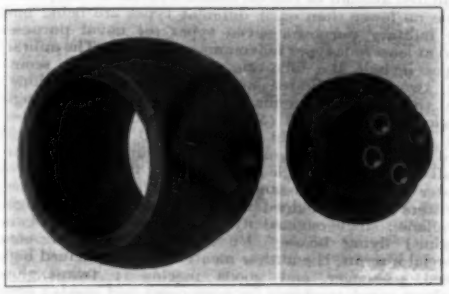


FIG. 9—VARIOMETER ROTOR AND VALVE HOLDER

with a view to minimising interference. The transmissions of the nearest stations, it is said, can be cut out, and those of other stations received without any interference. Besides the usual arrangements for tuning the set, a loosely coupled closed secondary circuit is provided, and in order to facilitate the reception of distant transmissions or receptiod when no interference is experienced from a nearby station, arrangements are made to enable the operator to use the aerial circuit alone. The third or low-frequency valve can also be cut out if desired. One of the other valves acts as a detector, and the other as a high-frequency amplifier. The tuner has a wave length range of from 300 to 2800 metres and, therefore, covers all the British broadcasting wave lengths and those of the French stations. As the apparatus is designed so that it can be used with a tuned closed circuit coupled to the aerial it is very selective. Two circular switches, each having ten studs and operated in conjunction with two condensers, enable the two circuits to be adjusted for different wave lengths. A vernier condenser is also provided in the closed circuit for fine tuning. There are also two change-over switches for connecting the condensers in series

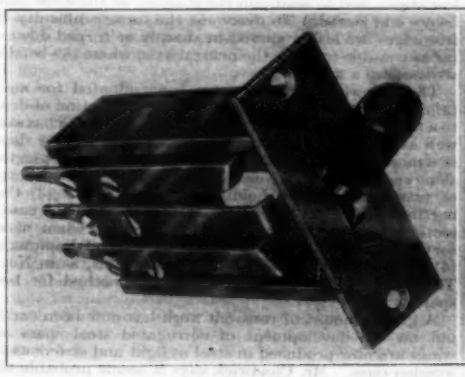


FIG. 10—ANTI-CAPACITY SWITCH

or parallel with their corresponding inductances. The grid potential of the high-frequency valve can be adjusted by means of a potentiometer, whilst the plate circuit of the high-frequency valve is tuned to the wave length of the incoming signals by means of a ten-point switch and tuning condenser. In the plate circuit of the rectifying valve there is a reaction coil which is coupled to the tuned inductance of the plate circuit of the high frequency valve. A two-way switch is provided for varying the inductive valve of this coil, whilst the coupling can be varied by means of a handle on top of the cabinet. All the valve filaments are controlled by means of separate rheostats. Another instrument shown is a two-valve low-frequency amplifier, which, by means of a switch, can be made to act as a single valve amplifier. The amplifier can, of course, be used in conjunction with the Siemens ordinary receiving sets, and will con-

siderably increase the volume. Other Siemens exhibits consist of loud speakers, wound for different resistances, inductance coils, headphones, lightning arresters, and dry cells. An interesting section of the stand is that devoted to ebonite, where all the ingredients used in the manufacture of this substance are shown. Samples of ebonite parts for wireless apparatus are also on view, such as valve holders, variometer rotors, &c. Examples of two of these parts are shown in Fig. 9.

Besides a collection of the well-known fixed and variable Dubilier condensers, the Dubilier Condenser Company, Limited, is showing various other accessories for use in the construction of valve sets, such as grid leaks, anode resistances, "Duncan" condensers

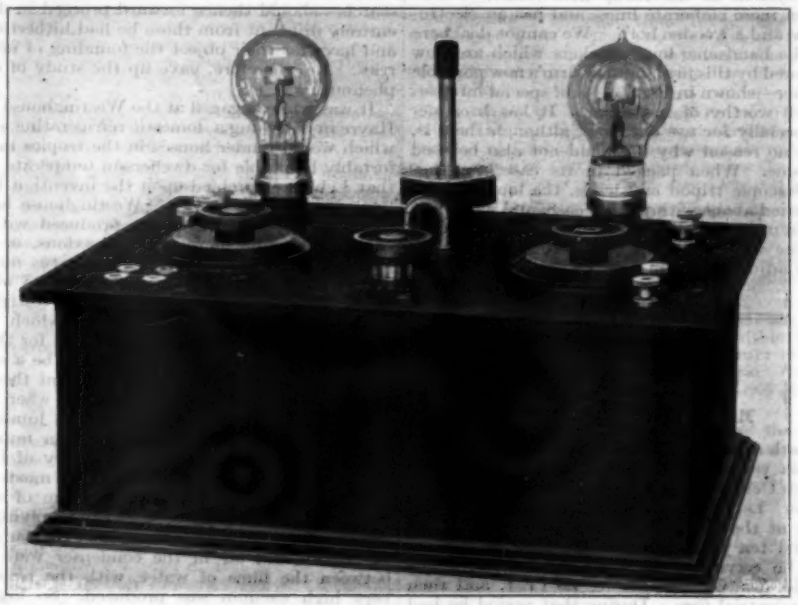


FIG. 12—GENERAL ELECTRIC COMPANY'S TWO-VALVE RECEIVING SET

for enabling the house wiring to be used as a receiving aerial, special types of screened variable condensers for use as precision instruments, and a new anti-capacity switch. This new switch—which is shown in Fig. 10—has been designed with a view to reducing the capacity to a minimum, and is, therefore, suitable for controlling the valves of receiving sets, and especially high-frequency valves. The grid leak resistances are designed for use with the company's well-known grid condensers, and the resistance is said to remain at a constant value under all working conditions. Tests have shown that they will withstand a pressure of 100 volts. The anode resistances —see Fig. 11—are made with resistances between 20,000 and 100,000 ohms, and as when in use they may be called upon to pass from 1 to 2 milliampères

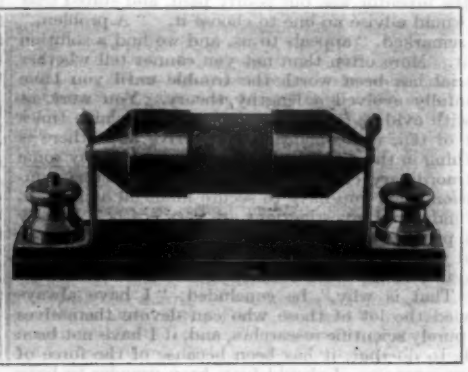


FIG. 11—ANODE RESISTANCE

they are tested at a pressure of 200 volts. As shown in Fig. 11, these anode resistances are supplied complete with spring contact clips.

A portable wireless receiving set, shown by the Marconi Scientific Instrument Company, Limited, is one of the company's most recent products. It is entirely self-contained, the aerial being in the form of a loop, which is arranged inside the lid of the box, and the batteries and telephones are fitted in special compartments.

An accumulator of the non-spillable type is provided, thus simplifying transport. The case, which measures 20in. by 14in. by 6½in., is made of the best quality leather, and is fitted with a strong handle and locks. There are six valves of the "V. 24" type, three of which are used for high frequency amplification, one as detector and the remaining two as note magnifiers. The set is worked with the lid of the box in a vertical position, and the directional properties of the aerial naturally make it necessary for the aerial to point towards the transmitting station it is desired to receive. All external connections are made to terminals, and several telephones may be used, although only one pair is supplied with the set. A Heterodyne Wave meter is another of the company's products designed to meet the requirements of the amateur and experimenter. The wave-length ranges of the different coils are controlled by a .001 precision variable condenser. The set has a wave length range of from 150–4000 m. The high-tension battery consists of suitable dry cells, which are incorporated inside the instrument. A pair of high-resistance telephones are included in the plate circuit so that the instrument may be used as a receiving or transmitting wave meter. A buzzer is provided so as to produce tonic train if required. The company's five-valve cabinet receiving sets are designed for those who require the utmost sensitiveness combined with simplicity of operation. They are capable of receiving all the British Broadcasting stations, also foreign telephony stations, and on favourable occasions some of the American broadcasting stations can be clearly heard. The valves are of the "V. 24" type. Two of them are used for high-frequency amplification, one acts as a rectifier and the remaining two are note magnifiers. The

FIG. 13—PORTABLE LOUD SPEAKER

latter two valves are connected through a three-position barrel switch so that three, four or five valves can be used at will. A change-over switch is also provided for switching on to headphones or loud speakers. All the filament resistances are controlled by means of a main filament rheostat which also serves as a switch. The instrument is enclosed in a well-made cabinet, with folding doors, which can be locked when the instrument is not in use. The two and three-valve instruments are similar in design to the five-valve set. Cabinet sets are produced in Jacobean, Chippendale, Sheraton and other styles.

The General Electric Company's exhibits comprise a complete range of "Geeophone" broadcasting receivers, including, among others, two crystal sets and a two-valve set—as shown in Fig. 12. This is a panel set, which is either sold complete or in parts, so that the set can be built up at home. The company

is also showing a very handsome four-valve cabinet receiver set, complete with a loud speaker and batteries. There is also a five-valve set. A new loud speaker made at the company's Peel-Conner Coventry works is shown, and a complete range of component parts for receiving sets, aerial equipment, a rejector unit and power amplifiers, are exhibited.

Alfred Graham and Company are showing a good collection of their well-known Amplion loud speakers which, as all people who are interested in wireless telephony know, are very widely used. The so-called Junior loud speaker, which is sold at a low price, is undoubtedly a very satisfactory instrument. Various other models are, however, now made. A more elaborate model is the "Amplion Junior de Luxe" which, whilst provided with the same electro-magnetic system as the cheap instrument, is constructed on more elaborate lines, and has an electro-plated base and a wooden horn. We cannot deal here with all the handsome loud speakers which are now manufactured by this firm, but the firm's new portable loud speaker—shown in Fig. 13—is of special interest, and is well worthy of inspection. It has been designed especially for use outdoors, although there is, of course, no reason why it should not also be used in the home. When packed in its case, together with a telescopic tripod and leads, the loud speaker can be carried about with perfect ease, and when it is required to use the instrument it is fixed to the stand in the same way as a camera. The height can, of course, be adjusted to suit requirements.

Obituary.

MAURICE LEBLANC.

The death of Monsieur Maurice Leblanc, at the age of sixty-six years, is reported as having taken place in Paris on October 27th.

Monsieur Leblanc received his early technical education at the Ecole Polytechnique in Paris, and for the first ten years after leaving that institution, in 1878, he served as an engineer, first with the Compagnie des Chemins de fer de l'Est, and then with an industrial firm. During that period he had not much leisure to pursue the natural bent of his mind, which was in the direction of scientific research. Yet he found time and opportunity to contribute several valuable articles to *La Lumière Electrique*, among which may be cited "Etude sur la transmission électrique des impressions lumineuses" (1880); "Etude sur la traction électrique (in collaboration with Monsieur Marcel Deprez, 1885); "Du rôle de la tension superficielle dans les phénomènes physiologiques" (1886); and "Etude sur le téléphone multiple" (1886).

In 1888 he definitely adopted the profession of electrician. At that period there were many electrical problems calling for solution, and he applied himself to their investigation. He first of all studied the question of alternating current motors and devised a machine with revolving brushes, which, however, he did not attempt to develop commercially, although, as he remarked later in life, he always regretted not having done so, and after a lapse of thirty years he stated that he fully believed that it was the best that had been invented. Monsieur Leblanc next turned his attention to the use of condensers in connection with alternating current motors. Tesla, in 1889, had produced his first commercial induction motors, but he had used as many wires as there were phases in the current he employed. He—Leblanc—had discovered that if he applied condensers to a monophase circuit it delivered leading current. He also found out that, if condensers were inserted in circuits connecting two points in the same network, monophase current could be converted into polyphase currents without the use of energy-consuming resistances. The idea came to him to utilise this discovery in order to do away with the multiplicity of wires which Tesla found it necessary to employ for his polyphase motors. He discovered, however, that resonance effects were set up in the circuits and that much higher potentials, which resulted in frequent accidents, were experienced. So he gave up the use of condensers and turned his attention to designing phase advancers, which he claimed to be the first to produce, and with which he appears to have had success as early as 1898. They were, however, not at the time eagerly taken up by the industry because, as he explained it, the central stations of that day were employed in supplying far more current for lighting purposes than for driving motors, or, to use his own words, "*les stations centrales desservaient avaient à fournir beaucoup plus de courants wattés que de courants déwattés.*" In fact, he was some twenty years before the times in this direction, and he was distinctly chagrined when phase advancers did come into use that he received no credit for their discovery.

Other electrical matters with which his name is connected were:—(*a*) The invention of what he called "*Circuits amortisseurs*" to prevent alternators when run in parallel getting out of step; (*b*) compound alternators; (*c*) harmonics extinguishers; (*d*) frequency changers; (*e*) rotary converters; and (*f*) various types of transformers. In connection with one or other of the foregoing he took out various patents, some of which, at any rate, were the property of "*La Société pour la Transmission de la force par electricité*," from which they were purchased in 1901 by Mr. George Westinghouse on behalf of the Westinghouse Electrical and Manufacturing Company and of the General Electric Company, the latter of which, it may be said in passing, had four years previously proposed to Leblanc that he should enter its service, an invitation which had not been accepted. This purchase of his patents brought Leblanc into direct contact with Westinghouse, an introduction which was to have a considerable effect on the life of the former, who was at once made consulting engineer to the Société Anonyme Westinghouse at Paris. Subsequently he entered the service of the great American, and in doing so undertook that his researches should thence forward proceed in directions entirely different from those he had hitherto pursued and have for their object the founding of new industries. He, therefore, gave up the study of electrical phenomena.

It was while engaged at the Westinghouse works at Havre in designing a domestic refrigerating apparatus which would render houses in the tropics more comfortably habitable for dwellers in temperate climates, that Leblanc stumbled upon the invention by which he is most widely known. Westinghouse had stipulated that the cold must be produced without the use of chemicals more or less noxious, or of fluid under pressure, and that the apparatus must be so simple that "it could be worked by an old nigger woman"! In the course of his investigations it became evident that the medium which must be employed was water vapour, and that for the proper working of the apparatus there must be a condenser which would give the highest vacuum theoretically possible. Condenser makers laughed when asked to produce such a thing, so Leblanc set himself to see whether or not he had demanded an impossibility when making the request. The story of his investigations is too long to tell here. It must suffice to say that by means of a special form of air pump comprising in a casing an element revolving at high speed and ejecting films of water at regular intervals, the steam and air in the condenser were enclosed between the films of water, with the result that a very high vacuum was produced. So high was it that, according to Leblanc, he and his fellow-workers were astounded at it. "Thereafter," he remarks, "all our condensers produced the theoretical vacua." "We had set out," he adds, "to produce an adjunct to a particular apparatus, and behold something had been discovered which had a wide variety of applications, and which could show an efficiency superior to that of the best types of piston air pumps. It, of all my studies, cost me the least trouble and occupied the least time. Yet it has achieved the best result industrially." "Truly," he commented, "the career of the inventor is full of disappointments! . . . Justice is not of this world!" Monsieur Leblanc's investigations covered a far wider field than has been indicated in the foregoing, but lack of space prevents us referring to them in detail.

Leblanc was, besides being a clever inventor and a painstaking investigator, a man of very considerable insight and a philosopher. In the document which he prepared when seeking election as member of the Académie des Sciences he lamented that the calling of the inventor was but poorly paid, and stated that he would advise no one to choose it. "A problem," he remarked, "appeals to us, and we find a solution to it. More often than not you cannot tell whether a trial has been worth the trouble until you have painfully evolved a lengthy theory. You work at it with avidity for five or six weeks, and, nine times out of ten, the conclusion you arrive at is there is nothing in the view that you have held. If, by some extraordinary chance, you reach a satisfactory conclusion, then you have to secure financial assistance, for industrial investigations are very costly. Finally you produce a machine which will work, and then you find yourself in the midst of commercial competition and face to face with conflicting interests!"

"That is why," he concluded, "I have always envied the lot of those who can devote themselves to purely scientific researches, and, if I have not been able to do that, it has been because of the force of circumstances. I should have been prouder to have discovered the most unimportant phenomenon than to have made the most successful application of it."

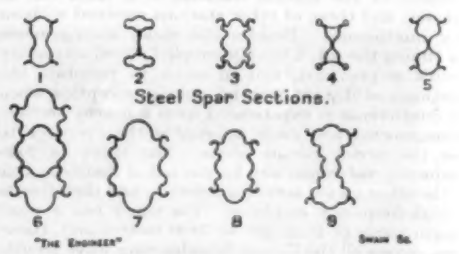
WILLIAM HENRY SAVILLE CRAVEN.

We regret to have to announce the death of Mr. William Henry Saville Craven, of the well-known firm of Craven Brothers, machine tool and crane makers at Reddish, near Manchester. Mr. Craven was the son of William Craven, one of the founders of the firm. He commenced his career with the firm forty-eight years ago, passing through the various departments of the works and gaining an intimate knowledge of the business of which he subsequently acted in the capacity of works manager, director, and, for the past twenty years, as chairman and managing director. His activities were not altogether confined to the mechanical side, for the new works at Reddish, which represent an admirable example of a modern workshop design, were built under his supervision. He was also largely responsible for the design of the carriage and wagon works at Dukinfield for the Great Central Railway, which were built under his supervision, as well as the new locomotive works for the South Manchurian Railway, Dairen, and others. Mr. Craven was actively associated with the iron and coal industry, having served on the board of the Staveley Coal and Iron Company, Limited, Chesterfield, for many years. He was a member of both the Institutions of Civil Engineers and Mechanical Engineers. His health broke down about two years ago, since which time he has been unable to take the same active part as hitherto, but he nevertheless attended the works daily and kept in close touch with business affairs. His death occurred at Sheffield on the 30th ult. quite unexpectedly, after attending a directors' meeting.

Aircraft Design.

In a paper read before the Manchester Association of Engineers on October 26th, on "Aeroplane Design," Mr. Roy Chadwick says that only about thirteen years ago makers of aeroplanes were elated if they turned out a machine which would fly satisfactorily with the pilot and a limited amount of fuel on board, whereas at the present time no fewer than eight different types are being built for military purposes, seven types for naval purposes, and at least four types for commercial work. The military types include the following:—(1) Single-seater scout; (2) two-seater fighter and photographic machine; (3) three-seater reconnaissance machine; (4) single-engined day bomber; (5) single-engined night bomber; (6) twin-engined night bomber; (7) and (8) single and double-engined ambulance machines. Naval aircraft includes: Single-engined ship fighters; three-seater fleet reconnaissance ship aircraft; fleet gunnery spotters; single-engined torpedo carriers; single-engine seaplane; single-engined flying boats; and large twin-engined flying boats. Under the heading of commercial aircraft, the author mentions single-engined high-speed passenger and goods machines; twin-engined medium-speed machines for passengers and goods; small "joy-ride" machine; and forest survey and fire patrol aircraft.

On the subject of all-metal aeroplanes, the author says that tubes are unsuitable for main plane spars except for



small machines, because for a given weight a large diameter of tube with very thin walls must be used in order to obtain an efficient section modulus to resist bending, and on these lines the limit of stability is soon reached. He says it has been found in practice that the diameter must not exceed sixty times the thickness if the full strength of the material is to be realised. It was, therefore, necessary to evolve special corrugated sections built up from high tensile steel strip from 12 to 28 thousandths of an inch thick. The great difficulties in producing these sections are to avoid premature crinkling of the free edges at a low stress, and to maintain the stability of the webs under heavy end thrust. To overcome the former difficulty the free edges are either curved-in sharply or turned down as far as possible towards the neutral axis, where the bending stresses are a minimum.

The following methods have been adopted for maintaining the stability of the webs:—(1) Reduction of depth to a minimum. Section Nos. 2, 7 and 8. Section 8 has same web as No. 3, .015in. thick, and although of greater depth is a more efficient spar. (2) Riveting two webs together along centre line as in Nos. 1, 4 and 5. This is the principle of two drunken men holding each other up. (3) Connecting together at intervals. This is done in the case of sections 1 and 9 by small distance tubes and when necessary with section No. 7, by means of bulkhead diaphragms. (4) Introduction of longitudinal diaphragms, as in No. 6. This appears to be the most suitable method for large spars.

A great amount of research work has now been carried out on the development of corrugated steel spars and wings are now produced in steel as light and strong as the wooden ones. Mr. Chadwick says it seems probable that before long all machines required to operate under varying climatic conditions will be built entirely of steel.

Prior to the meeting at which the above-mentioned paper was read, the members of the Society had an opportunity of inspecting the works of Crossley Motors, Limited, Openshaw, and A. V. Roe and Co., Limited, Newton Heath. At the former works the members were met by Sir William Letts. They were enabled to view the whole of the processes involved in the manufacture of motor cars and aeroplanes, and were favourably impressed by many of the machine tools in use at the former works. Some of the most original tools for special purposes have been built in the works, such, for instance, as a multiple drilling machine for gear boxes and engine cylinder blocks, worm gear cutting machines, &c. One of the machines seen is capable of drilling sixty-five holes at one setting with the aid of a simple jig. The employment of jigs on boring and milling machines was noted, as well as the thoroughness of the methods employed in the balancing of the moving parts of the engines, such as the connecting-rods and crank shafts. At the aeroplane works the processes employed in building flying machines of all sizes and types up to the latest bombing machines weighing 6 tons, fitted with 675 horse-power engines, were inspected.

Railway Matters.

Rail and road communication between the mainland and the Isle of Sheppey was restored on the 1st inst. by the re-opening of the river Swale bridge.

The Southern Railway Company's station at Elephant and Castle was badly damaged by a fire that broke out in the stables under the station on Monday night last.

Commendable brevity marked the formal proceedings of the Institute of Transport on Monday evening last. Within a few minutes of the opening, the new President, Sir Joseph Broodbank, called upon Major T. Salkield to deliver his lecture, illustrated by lantern slides, on "A Transport Adventure in Persia." At its close, a very hearty vote of thanks, proposed by Sir Henry Maybury, was given to the lecturer.

The report of the New Zealand Government Railways for the year ended March 31st last, states that the sixty-nine automatic signals on the 21 miles section between Wellington and Upper Hutt are working satisfactorily. They have proved their reliability and been of material assistance in facilitating traffic movements. It has been decided to substitute electric lighting for gas illumination on the Auckland-Wellington express trains.

Addressing a meeting of railwaymen at Hammersmith last week and referring to the attack on their pay, Mr. J. H. Thomas asked them to keep their heads and apply common sense to the situation. A circular had been issued by the London Council of the N.U.R—to all branches, and some of the names attached to it were those of men who ought to know better. A resolution had been passed instructing him not to sign any report of the National Wages Board that adversely affected railwaymen's conditions. He would not follow a blind policy that would weaken and cripple his position and render him unable to speak plainly and fairly.

In our obituary notice of Mr. H. A. Ivatt last week, we said that after his apprenticeship he became an ordinary fireman and "must have discharged the arduous duties well; for, in the latter part of the twelve months he served in that capacity, he was employed on fast express trains running north and south of Crewe." In this association, it may be remarked that Mr. Ivatt was the fireman of the limited mail which followed the tourist train that came to grief at Wigan early in the morning of August 2nd, 1873. He gave evidence before Captain—later Sir Henry—Tyler, and that officer's report spoke of him as "a highly intelligent witness."

According to the Board of Trade returns, the value of the railway material exported during the nine months ended September 30th last was as follows, the corresponding figures for 1922 and 1921 being added in brackets:—Locomotives, £2,117,597 (£3,783,202, £5,924,294); rails, £1,876,411 (£1,950,135, £2,218,421); carriages, £770,698 (£1,306,315, £1,155,576); wagons, £2,272,359 (£2,587,740, £4,357,148); wheels and axles, £724,174 (£985,356, £1,379,012); tires and axles, £455,302 (£328,363, £1,017,811); chairs and metal sleepers, £734,489 (£1,661,251, £973,931); miscellaneous permanent way, £838,153 (£1,087,939, £2,003,272); total permanent way, £4,865,077 (£6,154,383, £7,780,712). The tonnage of rails exported was 208,780 (193,020, 107,838), and of the chairs and metal sleepers, 64,337 tons (117,916, 40,726). During the month of September, locomotives to the value of £80,461 were shipped to India, £18,300 to South Africa, £18,085 to Australia, and £66,579 to countries other than British possessions or South America. Rails to the value of £62,185 were, during the same month, shipped to India, £64,642 to South Africa, £16,341 to British West Africa, £16,733 to the Argentine, and £140,894 to the other countries just referred to.

The total cost of the extensions of the City and South London sanctioned by the Act of last Session is estimated at £6,000,000, and work will be provided, including that in hand, for between 25,000 and 30,000 men for two years. The extension from Clapham Common to North Morden covers a distance of over 5 miles, and a commencement, it is hoped, will be made in about a month's time. For 4½ miles the railway will run in tubes, and seven new stations have to be constructed at Nightingale-lane, Balham, Trinity-road, Tooting-broadway, Colliers Wood, South Wimbledon and North Morden. The last will be a surface station, and the others underground. The tunnels of the extension are to be driven by a new type of electric rotary excavators, designed to carry out 20ft. to 25ft. of tunnelling a day, and it is hoped that the new line will be completed by the middle of 1925. A 2 min. service is scheduled, bringing Tooting within 25 min. of the Bank and Piccadilly-circus, and South Wimbledon within 33 min. of Moorgate. Provision will be made for carrying fifty million passengers a year, and at North Morden car sheds and repair shops to deal with 250 cars are to be built. If the date for the opening can be adhered to, a "record" will be set up in tube railway construction.

Speaking at Swansea last week, the Prime Minister stated that he had been informed by the chairman of the London, Midland and Scottish Railway Company that, in addition to current work costing £4,000,000, the company would anticipate its future requirements by shortly placing orders to the value of £10,000,000, for locomotives, carriages, wagons, rails, construction work and tools. Its workshops at Crewe, Derby, Horwich, Earlstown, Wolverton, Newton Heath, St. Rollox, Kilmarnock, &c., would be on full time, and thus benefit the towns in which they were situated. Some important widenings are to be put in hand, of which the most interesting is the provision of four lines of way between Crewe and Weaver Junction, where the line to Liverpool leaves the main line to the North. Thirty bridges are to be rebuilt and strengthened, and Tilbury Dock, Warrington and Bangor Stations are to be reconstructed. The adjoining Victoria and Exchange Stations in Manchester are to be combined. It is hoped shortly to proceed with the electrification of the lines between Manchester and Oldham, Shaw and Royton. New steamers are to be built for the services between Goole and the Continent, and a new ferry boat is to be placed on the Tilbury and Gravesend route.

Notes and Memoranda

About 45 per cent. of the world's production of fixed inorganic nitrogen is used for fertilisers; about 30 per cent. for making nitric, sulphuric and other acids; and about 25 per cent. for making dye-stuffs, fine chemicals and miscellaneous products requiring nitrogen.

It has been decided that in the process of moving the existing plant into the new Ford factory in Ontario all the machines shall be equipped with individual electric motors. As many as 2700 machine tools are involved in the change, and the output of the motors will range from ½ horse-power up to 75 horse-power. They will be supplied with 230-volt direct current.

The American Bureau of Standards has received a number of specimens of typical enamelling castings, and these are now being enamelled with several commercial cast iron enamels. The chemical analysis of the castings has been made, and the Bureau also proposes to make up typical bodies of cast iron in its metallurgical department. The specimens thus obtained will also be analysed chemically and enamelled. An attempt will be made to correlate the blistering of the enamel and the chemical composition of the cast iron, with the object of obtaining a good commercial cast iron which will not produce blisters.

The co-operation of two large steel plants in Alabama has been obtained by the United States Department of the Interior for experimental work in taking gas samples from the mantles of two commercial blast-furnaces. These companies have signified their willingness to drill holes through the shell and lining of their furnaces to permit taking gas samples from a number of elevations of the mantles. These samples will be used in a study of the reactions taking place in the stacks of commercial furnaces. The work is being done under the direction of the Minneapolis Experiment Station of the United States Bureau of Mines.

In a discussion of the relative merits of electrolytic and atmospheric oxygen for blow-pipe purposes, *Industrial Gases* says that extensive experiments show:—(1) If the quality of the oxygen is the same, the results obtained should be identical whether electrolytic or atmospheric oxygen is used. (2) A superiority of 0.5 per cent. in the quality of oxygen represents a saving of about 10 per cent. in the quantity. This difference does not, however, appreciably affect either the speed or the quality of the cut. (3) As between electrolytic oxygen of 99 per cent. purity and atmospheric oxygen of 98.5 per cent. purity the price of gas is the only important factor. If that is the same, then the electrolytic oxygen has a 10 per cent. advantage. These observations apply only to modern motor-driven cutting machines.

The engineers of the United States Bureau of Mines claim to be able to make iron successfully in a small furnace stack only 20ft. high, and the tests show that a considerable part of the stack is inactive, so far as reducing effect of the furnace gases or the ore is concerned, between the combustion zone and the zone near the top where reduction is actively going on. Since nothing happens in this part of the stack, if the same conditions hold true in commercial blast-furnaces, the present tall stack universally employed could be shortened, thus reducing cost of construction, and size and cost of equipment, such as the blowing engines that drive the furnace. Further work is being vigorously pushed with the object of co-relating the experimental results with those obtained in commercial furnaces. The furnace has a hearth diameter of 20in.

In a study of transmission of heat through steel pipes, being conducted at the Pittsburgh and Minneapolis stations of the United States Bureau of Mines, work on several sizes of steel pipes, calorised and plain, has been completed. Further tests will cover 2in., 4in., and 6in. pipes. Air velocities and temperatures in the heating chambers, as well as the size of pipes, are being varied over appropriate ranges. Temperatures are being measured in the centre of the pipes and in the heating chamber 1in. and 2in. from the outside wall. It has been found that steel pipes offer a higher resistance to the transmission of heat after calorising than before. Under the conditions of the test but slight effect was noticed on the calorised pipe, while the plain steel pipe oxidised quite readily. The results obtained furnish a basis for the design and construction of preheaters.

During recent years the A.E.G. Company of Berlin has made a number of careful investigations with condenser tubes in order to determine the best alloy and the best method of preparing the tubes from the alloy. The tubes in German practice are used either tinned or without tin coating. If tinned, the coat was made before the war from pure tin; during the war and in the first years after the war an alloy of 30 per cent. lead and 70 per cent. tin was adopted for the coat. The practical experiences of the A.E.G. have shown that, besides the composition of the alloy, the manner of producing the tubes is of the highest importance. Especially must the surface of the tubes be well polished, as if there is any unevenness this results in forming nuclei of corrosion. The alloys that gave the best results were the English alloy No. 1 Admiralty), and the German alloy No. 1 (38 zinc, 62 copper, no tin).

After many years of careful research work some engineers of the Marconi Wireless Telegraph Company have designed an instrument for the use of the deaf. The ordinary magnification of sound by means of the thermionic valve presents little difficulty to the wireless engineer, but the production of an instrument that is not too conspicuous, that is capable of giving fine control of volume, and of eliminating extraneous sounds, whilst at the same time being portable and reasonably cheap, has not been easy. The Otophone, which is the name of the new instrument and which is briefly described in the *Wireless World*, is enclosed in a leather attaché case, and it consists of a microphone valve amplifier and telephones. There is no need to talk at, or into, the microphone, which is fixed inside the the case. Any average sound within 10ft to 15ft. of the instrument is usually heard quite well, and at lectures or in a church where the speaker's voice is raised, the instrument can be removed as much as ten times that distance.

Miscellanea.

A new discovery of gold is reported from Wilge River drift in the Transvaal.

Work is about to be started on the development of 3000 acres of coal measures at Maitland, New South Wales, and a company, with a capital of £1,000,000, has been formed for the purpose.

A cotton ginnery started at Gondola, South Africa, by a company of British farmers, will deal with about 100 bales this year, says a Beira message, but anything up to 5000 bales may be produced next season.

The *Pioneer* says that good progress is being made with the erection of a high-speed wireless installation to operate between Rangoon and Madras, and it is hoped that the scheme will be in working order before the end of the year.

According to a cable from Tokyo negotiations are proceeding for the purchase by the Japanese Government of 1500 tons of nails and 5000 tons of zinc plates from Great Britain and 2,500,000 cubic feet of lumber from Canada for reconstruction work.

It is reported that the St. Regis Pulp and Paper Company, which has important mills at various points in the province of Quebec, is contemplating the establishment of a pulp mill at Cap Rouge, near Quebec City. The cost of the mill, it is said, will reach over 4,000,000 dollars.

The coal traffic at Lourenço Marques, Portuguese East Africa, where the new British-made coal-handling plant has recently been completed, is rapidly developing. During one week in October 16,164 tons were exported and 8855 tons bunkered. Eleven vessels entered the port and nine cleared.

A large central electric power station has now been completed at Ellamaa, Estonia, and within the course of a week or so will supply electric power to the State Railways between Reval-Hapsal-Baltiski, the wireless station at Hapsal, the towns of Reval and Hapsal, and various other places.

Official reports on the production of the Rivadavia oilfield of Argentina show that the July production was 39,750 cubic metres, which is roughly equivalent to the same number of tons, and is the largest production in any one month to date. From January 1st to July 31st the yield is given as 226,908 cubic metres.

In order to avoid initial mistakes in the handling of the South African Union crops of maize and other grain on the elevator system, a selected party of Canadians, who have experience in dealing with wheat in bulk at the great elevators at Fort William in Canada, has, according to the *S. A. Mining and Engineering Journal*, been engaged to visit South Africa.

Four new bridges are to be built across the Murray River, Australia. The sites recommended are at Abbotsford, Mildura, Euston and Gonn Crossing. The estimated costs are: Abbotsford, £78,000; Mildura, £98,000; Euston, £131,000; Gonn Crossing, £49,000. The two former bridges would be used for road traffic only, and the two latter for both railway and road traffic.

It is reported in the *Argus* that a farmer in South-West Africa, who was boring for water, struck a seam of coal from 13ft. to 15ft. thick, while another well spouted oil. A Government machine boring for water in the artesian area near Mariental is reported to have struck a seam of coal about 13ft. thick at a distance of about 130ft. from the surface and about 130ft. above the artesian table.

In view of the unfortunate experience of a number of Englishmen who have recently worked their way out to India in search of employment and have been disappointed on their arrival, states the *Electrical Review*, an official warning has been issued stating that it is highly undesirable for any Englishman to go out without first securing a definite post or having the prospect of pursuing a professional career.

A geological party which has been exploring the south and south-eastern parts of Colombia is said to have discovered deposits of platinum, gold, silver, copper, iron, and other minerals, and to have proved the existence of hydrocarbon deposits. The geologists also discovered rich oil deposits in parts of the Putumayo basin, and ascertained that the rivers could be easily made navigable almost to the headquarters, which are not a great distance from the Departments of Nariño, Cauca and Huila.

The Government of Bombay proposes, says the *Iron and Coal Trades Review*, to make it compulsory upon owners and users of boilers that there should be as boiler attendant a man of practical knowledge and experience in immediate and constant attendance on all boilers in use. The qualifications required will be far less stringent than those necessitated by the present first and second-class certificates, and it will be possible to employ men not of technical engineering education, but of practical knowledge. If this is adopted, it will no longer be compulsory on the owners of the boilers to employ certified engineers as distinct from mere certified boiler attendants.

An inter-Provincial Good Roads Congress was held at Quebec on October 10th, and at it seven provinces were officially represented, the attendance including the Prime Ministers of Quebec, Ontario, New Brunswick and Prince Edward Island. Arrangements were made for co-operation in highway construction and regulation. A committee will be appointed, consisting of officials of the Highway Department of each province, to secure the unification, as far as local conditions will permit, of the laws and regulations relating to road construction and traffic. The committee will also consider means for effecting economy in the purchase and handling of road building materials, and obtain data concerning the methods and costs of road construction and maintenance. The Congress strongly urged the need of further Federal aid in the construction of highways, and recommended that the grant of 20,000,000 dollars, made some years since for this object, should be renewed by the Dominion Government, the expenditure to be spread over a term of years. A tax on petrol, used in motor cars, was suggested as a means of raising additional revenue for highway construction and maintenance.

SOME EXHIBITS AT THE MOTOR SHOW AT OLYMPIA.

(*For description see page 496*)

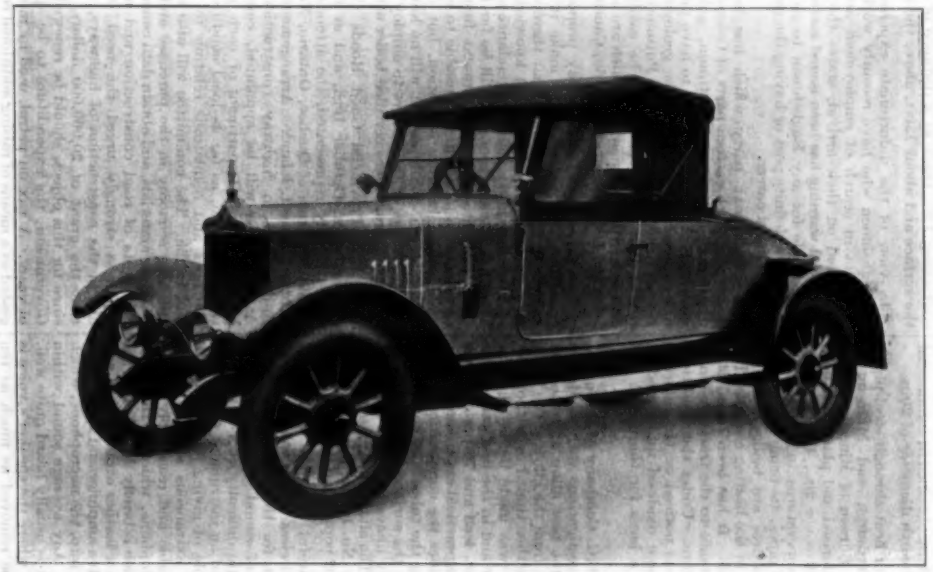


FIG. 21—14 H.P. TWO-SEATER STANDARD CAR

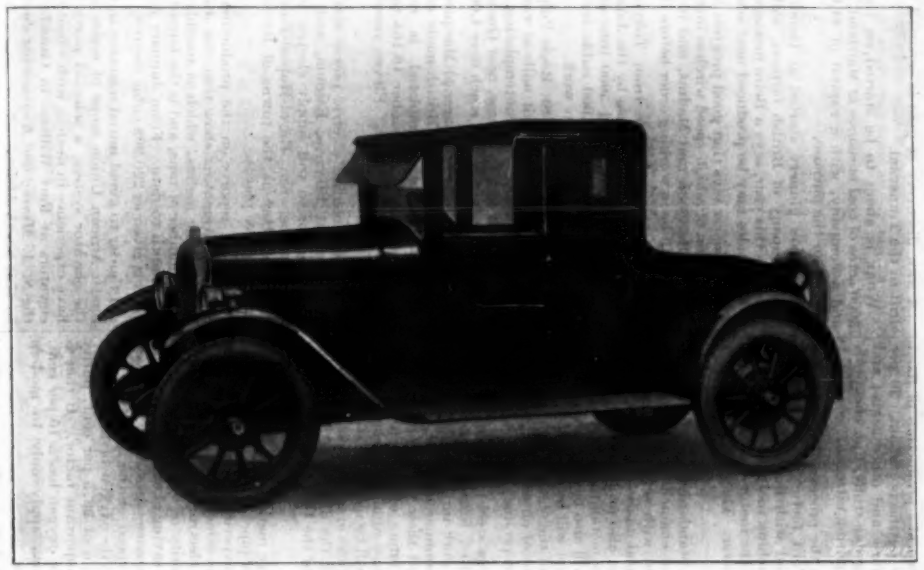


FIG. 22—TWO-SEATER CROSSLEY COUPE

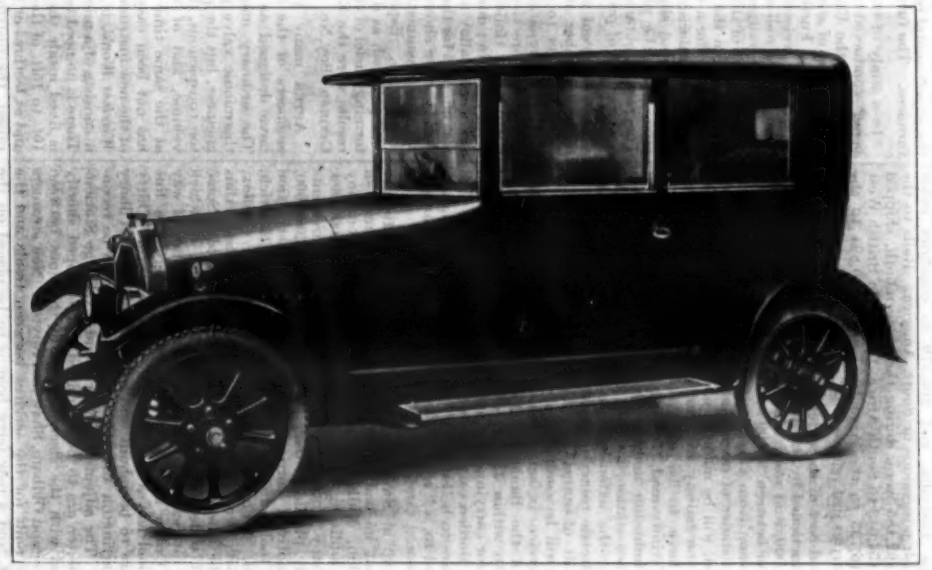


FIG. 23—11·4 H.P. "ALL-WEATHER" HUMBER CAR

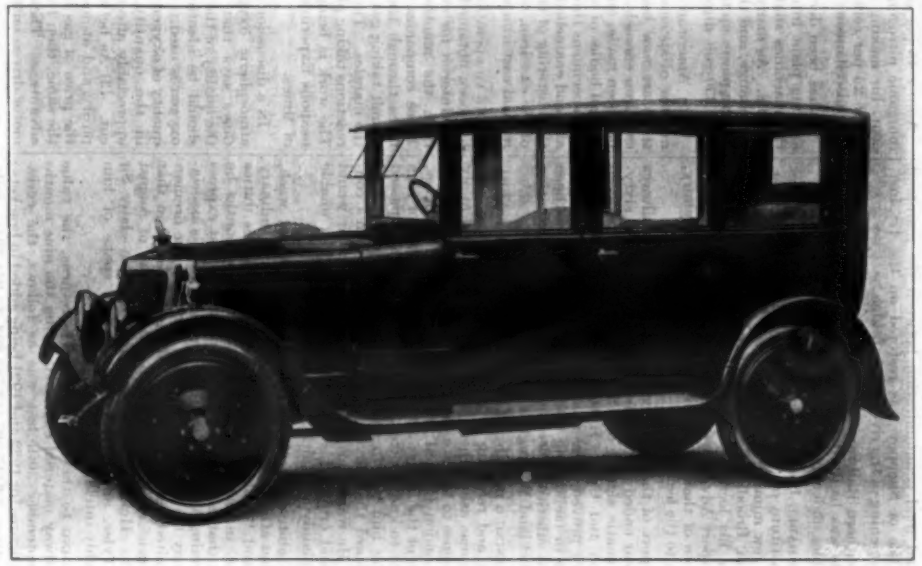


FIG. 24—16 H.P. ARMSTRONG-SIDDELEY LIMOUSINE

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THE ENGINEER.

NOVEMBER 9, 1923.

The Complexity of Natural Phenomena.

Although it is quite commonly believed that in the working out of all natural phenomena the forces and influences in action follow lines characterised by a grand and fundamental simplicity, it must be admitted that scientifically we have still remarkably little, if any, indisputable evidence that such is truly the case. The public faith in the fundamental simplicity of Nature's ways is complete, and even the scientific research worker, open-minded though he honestly strives to be, is frequently influenced by the same belief, sometimes perhaps to an extent of which he may be wholly unconscious. Faced with two alternative explanations of some phenomenon, he will more often than not choose the simpler on no other grounds than because, in its simplicity, it appeals to him as being most in accordance with his conception of Nature's processes and ways. When, too, he "fairs" a number of plotted points to a smooth curve, he is influenced by the same primitive instinct, for he is tacitly assuming that any departure from simplicity revealed by his investigations is a reflex of the imperfections of his observational means rather than evidence of genuine complexity in the forces at work in the phenomenon being studied. We do right, no doubt, to encourage a spirit of mistrust in our observations of Nature, to view with suspicion, for example, "proofs" of a new theory based upon the measurement of a fraction of a second of arc on the surface of a photographic plate. But while such mistrust or suspicion is, in general, desirable, scepticism should not be carried so far as to deny the possibility of any result being true simply on the grounds of its complexity. Far from there being strong evidence in favour of the ancient and still popularly held view that Nature is fundamentally and essentially simple, the development of scientific observation seems ever more strongly pointing towards the belief that at the core there is a state of complexity almost, it might seem, beyond the power of the human mind to probe and understand.

With each new refinement in our means of observation, we perceive that what we thought simple is in reality complex, that what was once readily grasped and easily capable of being formulated into a simple "law" is really amenable to a control of apparently ever-widening complexity. The simple gas equation $PV = RT$ represented the truth to Boyle and Charles and their contemporaries, for with the experimental equipment at their disposal it agreed, within the limits of human fallibility, with observed facts. Moreover, it had the merit of presenting an easily grasped mental picture of the effect of temperature and pressure on the volume of a given weight of gas. Subsequently, it was discovered, when the experimental equipment was made more refined, that no gas behaved in accordance with it, some, indeed, showing considerable disagreement. The modification introduced by van der Waals eliminated much of the discordance, and although his equation showed relative complexity when compared with the earlier one, it still left us with a tolerable picture of a gas under varying temperature and pressure, even with the matter complicated by the introduction of molecular attractions and volumes. Renewed investigations with still more refined equipment showed, however, that van der Waals' equation contained two "constants," which for any one gas really varied with the temperature. It is on record that over thirty attempts have been made to bring the equation into agreement with observed facts. According to Dr. J. W. Mellor, one of the best of these attempts was that made by Dieterici. The mathematical expression of the law arrived at by this investigator is still more complicated than van der Waals' equation. It contains as a factor a negative power of the base of the natural logarithms, and virtually defies the formation of any precise mental picture of the law. Even it is now known to be merely a third approximation to the truth, for one of the "constants," there is evidence for believing, decreases when the pressures become very large. The theory of elasticity abounds in illustrations of the fact that the apparently simple in Nature is really complex, although in this field the demonstration of the absence of simplicity cannot be made with much precision by reason of the relatively gross nature of even the most refined measuring appliances which have yet been evolved. The most convincing example to be obtained is perhaps that provided by an examination of the truth of Hooke's law. The simple statement that up to a point the strain suffered by a specimen of matter is proportional to the stress applied to it, has, it is now well known, to be qualified by many reservations. For many materials it is not even approximately true, being, for example, notably inaccurate for cast iron, and for those substances, such as mild steel, to which it applies with fair truth, it is now known that as our means of measuring stress and strain are improved, the shorter becomes the range over which the "law" can be accepted as a satisfactory expression of the observed facts. The inference must therefore be drawn that with sufficiently refined means of observation, Hooke's simple law would be seen to be lacking in precision and to require replacement by other approximations of increasingly complicated natures. It must not be forgotten that the measurement of strains with great accuracy is still scarcely possible. A mild steel specimen 5in. in length stretches less than one two-hundredth part of an inch at the elastic limit. To secure an accuracy of 1 per cent. we must therefore measure the strain down to the last twenty-thousandth part of an inch. Even on Professor Dalby's optical recorder, which magnifies the extension in the ratio of one to 150, the determination of the strain at the elastic limit correctly to within 1 per cent. requires the image of the spot of light on the photographic plate to be fixed with an error which must not exceed one hundred and thirtieth of an inch. Since departures from Hooke's law can definitely be detected in most metals, although no attempt, so far as we are aware, has been made in any one instance to formulate them, the inference seems to be that the departures in question are at least of the order of 1 per cent. Other examples illustrative of the essential complexity of the apparently simple might be given, but in order that a just picture of the truth may be presented, it must be observed that in at least one instance that which appears simple would seem to possess genuine and fundamental simplicity so far as we can say at present with any assurance. In Ohm's law it is fairly certain we have the simple expression of a simple relationship, which actually does hold good in Nature. That law would be upset if it could be shown that the electrical resistance of a conductor preserved at a constant temperature were in any way dependent upon the current flowing in it. As long ago as 1876 this subject was investigated at Clerk Maxwell's suggestion at the Cavendish laboratory. It was found that if the resistance of a conductor was affected by the current flowing in it, it could only be so to an extent represented by less than the one million millionth part of its normal value per ampère of current traversing it. The exactness of Ohm's law and the experimental evidence adduced in support of its strict accuracy have since been

questioned by some people, but it still seems safe to say that the balance of opinion is in favour of regarding the law as a precise statement corresponding to a simple natural condition.

The most striking feature revealed by these studies is the almost tantalising nearness with which Nature in very many cases approaches simplicity without, except in a few and possibly doubtful instances, ever achieving it. We know that water is only very slightly incompressible, but according to Tait the small departure from incompressibility has the very important effect of bringing above the sea level some two and a-quarter million square miles of land surface that otherwise would be submerged. We know that certain familiar reactions, such as the burning of sulphur, phosphorus, carbon and carbon monoxide, will not take place, or will do so only with great difficulty, even in pure oxygen if the substances are completely dry, and that only a minute quantity of moisture is required to restore what everyday experience has led us to regard as the "correct" behaviour of the substances. Is it possible that in these and similar facts we may perceive the working out of a principle which is also illustrated in Nature's frequent departure from complete simplicity in the ordering of her phenomena? Is it possible that what appear to us as uniformity, simplicity and law are merely the mean representations of a series of variations, and that the lack of uniformity, the complexity and the departure from law which we seem to be increasingly able to detect are in reality glimpses to one side of the range through which Nature's controlling forces vibrate!

Engineers and the Future.

It was pleasant to listen to the cheerful words of Sir Charles Morgan in his presidential address to the Institution of Civil Engineers on Tuesday evening. There is no denying the fact that engineers in all branches of the profession are depressed; but Depression is an ill companion to work with, and we shall all be the better for taking some of the optimism which Sir Charles offers to us and by endeavouring to look with some of his hopefulness towards the future. But future prosperity will not pay present bills, and it takes a deal of courage not to feel that the profession is really going to the dogs when month after month passes without any steady improvement. Even the account of the rosy age of engineering, the 'seventies, when, as Sir Charles told us, he began his apprenticeship in the bustle of railway development, and when the committee rooms of the Houses of Parliament were overwhelmingly full of work, might present a contrast calculated rather to increase than decrease our despondency were we to keep looking back through the President's eyes to those industrious days and not follow him into his visions of equally prosperous years ahead. But that prosperity will not come by the mere wishing for it; engineers have got to make it for themselves. The past *may* repeat itself; more likely it will not do so, and if engineers, particularly "Westminster" engineers, are to enjoy once again such prosperity as was their lot fifty years ago, they may find it necessary to carve out new ways of development. "If I and my contemporaries," said Sir Charles, "who fought our early battles amid the prosperity and expansion of the 'seventies, were complacently to shut our eyes to the seriousness of the present situation of junior members of the profession, we should be failing in our duty, and, I think, failing also in common sympathy and understanding. It is the part of such an Institution as our own to face the truth squarely and to do all that can be done, by organisation, encouragement and co-operation, to hasten that recovery of the whole profession to which we all look forward."

Sir Charles Morgan has been associated for very many years with railways, first as chief engineer of the London and Brighton and then as one of the directors of that company. Hence it was natural that he should turn his attention in his presidential address to the Metropolitan traffic problem. He made no detailed suggestions for solving that problem, but was content with the happy view that "whatever the solution may be, it will bring work to engineers. Developments of engineering have created the problem; further developments will solve it." That view might almost be regarded as the essence of Sir Charles's philosophy and certainly as the framework of his hopes for the future. For in another place, in answer to the question "What lies ahead for the community in general and for our profession in particular?" he said: "Science creates a need for science; it solves one problem only to create another, which it solves in its turn." A little doubt about the truth of that conclusion, as far as it is associated with London traffic, would be excusable. Engineers have in fact done little, so far, to mitigate the trouble. They have, indeed, augmented the facilities for communication, but thereby have increased rather than diminished the congestion. In that way their work has led to more work, but it may quite fairly and seriously be asked whether the time has not come when the further development of London should not be checked rather than encouraged by the increase of traffic facilities. Some years ago it was shown, if our memory serves us, at a meeting of the Institution of Electrical Engineers, that every step in the progress of suburban traffic had increased the crowding of London. One has only to consider the condition at the present time to feel that whilst the development of methods of passenger transport compel the highest admiration, they have not materially reduced the severity of the problem. A more rational solution than the present one would be the establishment of a chain of nuclei some twenty to twenty-five miles from London, in which different industries might be segregated. We can, for example, imagine the whole of the insurance business being conducted at Luton, whilst the meat industry might with advantage be transported to some point down the river. Such nuclei would create a centrifugal tendency in place of the centripetal tendency which now causes the dense crowding of the heart of London, and there is no reason to suppose that engineers would find less work were such a policy put in practice. There would of a certainty be at least as much, but it would be better ordered, better expended. "The task of the nineteenth century was to enlarge, to expand, to grasp at each new source of power and develop it, sometimes without full thought of social consequences"—we quote again from the President's address:—"The task of the twentieth century is to bring back to life some of that order and leisure and spaciousness which was submerged in the too hasty tide of Victorian prosperity. Engineers who, if I may say so, were largely responsible for the prosperity, will be called upon in the future to undertake the great task of simplification and organisation and reconstruction, without which that prosperity cannot bear its fullest and best fruit." We agree; yet it is hard to see how the simplification and organisation of the London traffic problem can be effected as long as the present system continues.

With the general theme of Sir Charles Morgan's address we should like to express our hearty accordance. No one can seriously doubt that sooner or later prosperity will return to British engineers and British engineering. Whether the prosperity will be secured by political action or whether it will arrive by natural causes we do not venture an opinion. But as it is quite certain the world has no intention to mark time indefinitely, a change must come in due course, and British engineers, who have always enjoyed and who still have every right to enjoy a high reputation for design and execution, will find themselves as busy as they were in the best days before the war. We hear already of signs of recovery in the Russian market, and we are justified in hoping that the recent Empire Conference will have useful results in our own Dominions and Colonies, whilst the Exhibition of next year will fail hopelessly in its intention if, unlike other international exhibitions, it does not give a fillip to trade.

The Institution of Civil Engineers.

PRESIDENTIAL ADDRESS

By Sir CHARLES LANGBRIDGE MORGAN.

The profession of engineering, in common with all other professions, is passing to-day through very troublous times. The young men who now enter it, often with an equipment of scientific knowledge and of general education which would have been regarded as exceptional in the Westminster offices of my own early days, are yet confronted by extraordinary difficulty in obtaining work. It must be discouraging to them sometimes. They must sometimes be tempted to believe that the profession of civil engineering has entered upon a permanent decline and that they will never find that outlet for their energy and enterprise which any young man, who has to make his way in the world, is entitled to expect. I believe that all such counsels of despair are false counsels, but that there is at least apparent reason for temporary discouragement no one can deny. In this address upon the prospects of those engaged in or intending to follow the profession of engineering, I propose to give you the grounds upon which that opinion is based. But, before I look forward to the days to come, it may, perhaps, not be inappropriate that I should look back to the days that have gone by, so that we may consider the circumstances of the profession more than fifty years ago, and, having in the briefest outline traced certain aspects of its development, pass on to consider the circumstances of to-day and to look forward to those of to-morrow.

I propose, therefore, to give a short account of conditions as I found them in 1870 when I began my pupilage at Westminster. Now, in 1870, there was great activity in the promotion of schemes for new railways by the then existing railway companies, by private companies, and by professional promoters. A professional promoter—now almost squeezed out of existence—was one who, with the aid of a syndicate, promoted Bills in Parliament, and, if successful in obtaining an Act, took the first opportunity to dispose of his powers to one or other of the rival companies in the district to which his powers applied. The committee rooms of the Houses of Parliament were overwhelmingly full of work, and, whether in promotion or opposition, great pressure was upon engineers in committees. This busy atmosphere, so satisfactory to the profession and of such good omen to the country at large, has, I regret to say, almost disappeared, and the older members of the profession, who find themselves nowadays in the corridors and committee rooms, are sometimes a little depressed by their present aspect. It is difficult to imagine, even in normal circumstances, that the bustle and life will ever return again, and it seems less likely than ever now that we have the "Grouping of the railway systems," and so many matters previously dealt with in the committee rooms are now settled by the officials of Government departments.

In 1870 the provision for public locomotion in inner London was by rail on the sections of the Metropolitan and District Railways as follows:—

	Opened.
Metropolitan Railway—	
Paddington to Farringdon-street	1863
Hammersmith Line	1864
Farringdon-street to Moorgate-street	1865
Baker-street to Swiss Cottage and South Kensington	1868
L.C. and D. Junction to Farringdon-street and Widened Lines to Moorgate-street	1866-68
East London Line, New Cross to Wapping	1869
District Railway—	
South Kensington to Westminster and Blackfriars	1868-70
Blackfriars to Mansion House	1871

You might travel also by the penny steamboats, though after many vicissitudes they ceased to run; by hansom cabs, four-wheelers, and the horse-drawn omnibuses. Upon an omnibus, if you were athletic enough, it was a privilege to get a box seat next the driver, and not only learn your London, but some of its choicest vocabulary, of the kind known only to the drivers and understood by those with whom they exchanged terms of "endearment" when passing. These means of travel were already beginning to be found inadequate for the needs of an increasing public.

The Great Eastern Railway Company, under the powers of their 1864 Act, were pressing on with the construction of their suburban and metropolitan extensions, including the provision of the City terminus at Liverpool-street, but none of these works was brought into use before 1872.

Credit must, however, be given to the Great Eastern Railway Company for being the first company to make special provision for the traffic from the outer suburban area. It was a bold policy, and the building development following the construction of the railways proved it to be a sound one. It formed, indeed, the turning-point in the success of that company.

During the period 1870–90 many extensions of the inner and outer suburban lines were brought into use, including the Inner Circle Line, in 1884, and the pioneer tube, the City and South London Railway—Stockwell to King William-street—in 1890.

We get, then, a jump of ten years. In 1900 the City and South London line was extended at one end—King William-street—to Moorgate-street, and at the other—Stockwell—to Clapham Common, and in the same year the Central London line was opened between the Bank and Shepherd's Bush.

The increase in number of passengers carried in 1920 on

Local railways	over that of	1870	is equal to	1104.3 per cent.
Suburban lines	,,	1902	,,	68.5 ,,
Tramways	,,	1880	,,	1544.3 ,,
Omnibuses	,,	1870	,,	2080.0 ,,

The total 1922 figures show a falling off of 5 per cent. from the 1920 figures after allowing for an increase of 6 per cent. in the omnibus numbers.

Journeys per Head of Population.

Year.	Local railways.	Suburban sections of main line railways.	Total railways.	Tramways.	Omnibuses.	Total.
1870	16	Not available	—	—	11	—
1880	28		—	14	12	—
1890	30		—	34	27	—
1900	33	29	62	52	41	159
1910	59	34	93	106	53	256
1920	93	49	142	143	125	418

The result is an increase of journeys per head in 1920 over that of 1900 as follows:—

	Per cent.
Railways	129
Tramways..	175
Omnibuses	205

In 1870 the working of twenty trains per hour on the Metropolitan Railway was considered good, whereas to-day on certain sections the number has doubled, this being possible principally owing to electric traction and automatic signalling.

One of our motor-buses to-day, for the reasons stated, provides for the public requirements accommodation equal on a safe estimate to about six of the old horse buses.

The few figures I have quoted deal only with public vehicular passenger traffic and therefore touch not more than the fringe of the problem of road congestion. When we consider, in addition to this, the enormous increase in road traffic resulting from the general development of our trade, not only in factories and business premises but in the docks and by the riverside, it is clear that the problem is even more urgent than my figures, taken alone, would suggest. A single instance of the increased use of the roads is the great growth of road transport from dock to wholesale merchant, and from merchant to retailer. Vehicles engaged in this traffic, which obstruct the roadways in the process of loading and discharging, are among the most serious causes of the present unsatisfactory condition. Another cause is that the hours of work are less spread than formerly, there being a nearer approximation to a common time for the beginning and ending of work. This concentrates the "peak load" of all means of transport upon shorter periods. A further cause, and a fast-growing one, is the increasing density of the business population. When old premises are rebuilt, the new premises have in some cases new floor space below and above pavement level, and give more than double the area of the buildings displaced. Thus, "peak traffic" is given additional local concentration and further road congestion inevitably results.

That, in rough outline, is the nature of the problem as I see it. I shall not attempt here to make detailed suggestions for solving that problem. It is very serious, very urgent, and becomes more urgent every day. Whatever the solution may be, it will bring work to engineers. Developments of engineering have created the problem; further developments will solve it.

Everywhere the same story of developments which will insist upon further development is repeated.

Our great municipal authorities have carried out works of street improvements, great works of sewerage, and have been very active in all matters affecting the public health.

There is at the present time great activity in the construction of arterial roadways, so as to admit all classes of fast motor traffic. I venture to hope that some special provision will be made for direct levy on the users of these roads; otherwise there will be an unfair burden—even if the first cost is otherwise provided for—upon the ratepayers. Upkeep and reconstruction is a very serious expense on present roads, a much more serious one on these arterial roads, where the traffic will be heavy and the speed will undoubtedly be high.

Remembering the high efficiency of the present steam locomotives, and their elasticity under load, I view with very considerable doubt the desirability as a commercial proposition of the application of electric traction to main line traffic.

Whatever may be the future of electric traction on the railways in this country, it appears to me—apart from all other considerations—to be most necessary that a common system should be standardised, so as to allow of free and complete interchangeability of rolling stock over the lines of the various railway companies. We have had experience in the past of the hampering of trade by differences in gauge. Let this lesson be our warning not to make any analogous error in our electrical systems. Circumstances might easily arise now that we are no longer a "tight little island" where any obstacle in the free interchangeability of traffic might be fraught with great danger.

I have now set out in a very sketchy way some of the expansion that has occurred within my own professional life. All of it has brought work to engineers in particular, and to men engaged in kindred professions.

Many things which to-day seem almost commonplace and part of our daily life, were not anticipated or even thought of in 1870, but if we go a little farther back to the beginning of the nineteenth century, the advance has been proportionately even more remarkable. Are we to stop at the position at which we have arrived, or are we to maintain our hope of the future? What lies ahead for the community in general and for our profession in particular?

The answer, I think, lies in the fact that science creates a need for science. It solves one problem only to create another which it solves in its turn. Steam transport came as an answer to the industrial revolution at the end of the eighteenth and the beginning of the nineteenth century; it linked town with country; it multiplied opportunities for human activity, and, in consequence, it increased population. It brought that population to the towns. Mr. Fletcher, in the fourth volume of his "History of England," tells us that "in 1801 there were 152 and in 1901 there were 558 persons per square mile in England and Wales. The total population was nearly quadrupled during the nineteenth century. The proportion of those living in towns to those in the country was almost exactly equal in 1851. In 1901, 75 per cent. of the total lived in towns." Road congestion, to which I have already alluded, is but an example of the problems created by this change, which it will, in the future, be the duty and privilege of engineers to solve.

Moreover, work will come from two never-failing sources—from the obsolescence and supersession of existing work and from entirely new inventions. There is now and must always be, continuous scrapping and renewal. As an illustration of recent work of this character, take the City and South London Railway. This was constructed in 1890 and some of it so late as 1907. It is now being reconstructed so that full-size tube stock may work over it. Take again, Liverpool-street Station—G.E.R.—which was an entirely new terminus erected in 1874. In 1894, after an interval of only twenty years, it was considerably enlarged and additional approach lines were constructed, and both Victoria—L.B. and S.C.R.—and Waterloo—L. and S.W.R.—which were reconstructed comparatively recently, are already working at their full capacity during crush hours. We have had a like experience in harbours and docks and in all public utility undertakings. All such work of reconstruction is continuous. In most cases it is more difficult to carry out than original work, because provision has to be made for the continuation in use of the existing undertakings, and there is the greatest need for highly-skilled engineers.

As regards new inventions of a sort which give a fresh impetus to the whole profession, it may not be our good fortune, in the immediate future, to have some great new discovery which, like the application of steam to power, will open a new era for engineers. We do not know. It may happen. If not, we are still left with sufficient cause for hope. The Victorian era has created more problems than it has solved. There is no sort of finality in the past; no reason to anticipate stagnation in the future. During the nineteenth century discovery and development came so fast that they have resulted in overcrowding, often in confusion. It is our present task to unravel the tangle. We have social, political, and imperial problems of a type and magnitude that were undreamed of fifty years ago. The task of the nineteenth century was to enlarge, to expand, to grasp at each new source of power and develop it, sometimes without full thought of social consequences, to its fullest extent. The task of the twentieth century is to bring back to life some of that order and leisure and spaciousness which was submerged in the too hasty tide of Victorian prosperity. Engineers who, if I may say so, were largely responsible for the prosperity, will be called upon in the future to undertake the great task of simplification and organisation and reconstruction, without which that prosperity cannot bear its fullest and best fruit.

I see no reasonable limitation to further advance and progress. Many of the great discoveries and their application to our use are in their infancy. I believe, notwithstanding the present obscure outlook, and the abnormally depressing times engineers have recently been through, brought about principally as an aftermath of the Great War, that the prospects of work for the profession in all its many spheres of activity are full of hope and promise.

In addition to new developments, we have large works of reconstruction going on to meet the pressing demands of the present, and if we bear in mind the enormous advances of unthought-of works made in my time, which I have so imperfectly reviewed, we have, I think, a right to believe that a bright and successful career is awaiting the profession, particularly those members of it who are fully equipped in character and training, and are hard workers.

Literature.

SHORT NOTICES.

Hutte Des Ingenieurs Taschenbuch. Vol. II. 9s. Wilhelm Ernst and Sohn, Wilhelmstrasse 90, Berlin, W. 66.—When reviewing the first part of this handbook, we called attention to the fact that this year, for the first time, it is appearing in three volumes, the second of which is now to hand. Broadly speaking, it is devoted to mechanical, marine and electrical engineering, and forms a book of some 1288 pages, or 200 pages more than in the previous edition. The first section is devoted to boilers, steam engines and turbines, internal combustion engines and water turbines. New material is given relating to the details of boiler construction and the calculation and construction of steel chimneys, while the chapters on the theory of the steam engine and turbine have been revised and enlarged to take in the most recent practice. Section II. deals briefly with the testing of prime movers and the determination of the various measurements it is necessary to make for such tests. An important section is the third, which includes metal and woodworking machine tools, and an extensive section on cranes and transporters. The subject of the handling and stowing of materials and liquids is handled at length, and this part of the book closes with a description of present pump, fan and compressor practice. Shipbuilding and marine engineering in all branches form Section IV. This part of the book has been entirely re-written, and a chapter on reinforced concrete ships has been added. The fifth and sixth sections are devoted to automobile and aeronautical engineering, and the technique of lighting respectively. Electrical engineering forms the subject of the seventh, or last, section, which has been enlarged by the addition of a special chapter on the testing of electrical machinery. A well-arranged index to both Vols. I. and II. is included with this volume.

Laminated Springs. By T. H. Sanders. London: The Locomotive Publishing Company, Limited. 1923. 25s.—We have no recollection of a book dealing exclusively with springs for vehicles, and therefore welcome Mr Sanders' work, especially as it treats the subject in the most open-minded manner and gives all due mead to American and continental experience. The early part of the book is concerned with springs in the abstract and the steel from which they are formed, and in this connection the author explains Youngs' modulus, showing that a spring made of dead soft steel will have exactly the same unit deflection as one made of the best quality spring steel, hardened and tempered. The general theory of laminated springs is elaborated, and the belief that the friction between the several leaves is an important function is controverted, while the futility of specifying a wide range of thicknesses for the plates is exposed. The author does not appear to favour fancy-shaped "spear" ends to the leaves, rather advocating plain square ends. The latter part of the volume is devoted to the practice of spring making, but we think that the author must have made a slip where he says, on page 323, that the workers are in greater danger when working hot stock than when using cold material.

Railway Signalling: Mechanical. By Fras. Raynar Wilson, Victorian Government Railways. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. 6¼in. by 4¼in. 103 pages, 75 illustrations. 2s. 6d.—In the literature on railway signalling, the subject has hitherto only been considered in either the rudimentary stage or the highly technical aspect. The student, on the one hand, and the signal engineer, draughtsman or inspector on the other, have been catered for, but there has not been the happy mean which provides for the civil engineer who needs more than mere groundwork and who yet is not immediately concerned in the manufacture of signal-boxes, signals, locking frames, level crossing gates, &c. The present writer, in this the companion work to his "Railway Signalling: Automatic," reviewed in these pages on June 15th last, has managed to give engineers, locomotive men, railway operating officers, and the vast multitude of the general public who are interested in signalling, excellent instruction on the subject in a manner which serves the three-fold purpose of being elementary, general and technical.

Mechanics of Machinery: Mechanism. By Robert C. H. Heck. London: McGraw-Hill Publishing Company, Limited. 1923. 25s.—This is the first of two volumes. In the second, which has yet to be published, it is proposed to deal with the kinematics and dynamics of machines. The present volume is evidently intended more for the student than the practical engineer, although the latter might well find it useful in refreshing his memory about more complicated matters. The work is not so abstruse as some of the standard books on the subject, yet it goes far enough to give the reader a good insight into the theory of mechanisms, while interest is maintained by frequent practical examples. A subject not always met with in books of this class is Valve Diagrams, and Mr. Heck has treated it in a comprehensive and lucid manner. The volume is well illustrated.

BOOKS RECEIVED

Mechanical Road Transport. By C. J. Conradi. London: Macdonald and Evans, 29, Essex-street, Strand, W.C. 2. Price 21s. net.

The Law of the Car. By W. Gordon Aston. London: Percival Marshall and Co., 66, Farringdon-street, E.C. 4. Price 2s. 6d. net.

Coke and Its Uses. By E. W. L. Nicol. London: Benn Brothers, Limited, 8, Bouverie-street, E.C. 4. Price 19s. 6d. net.

International Review of the Science and Practice of Agriculture. Rome: Printing Office of the International Institute of Agriculture.

Practical Moulding. By S. Jones Parsons. London: George Routledge and Sons, Limited, Broadway House, Carter-lane, E.C. 4. Price 5s. net.

Proceedings of the South Wales Institute of Engineers. Vol. XXXVIII. No. 8. Published by the Institute, Park-place, Cardiff. Price 10s. net.

Coal Tar Distillation and Working up of Tar Products. By Arthur R. Warnes. London: Benn Brothers, Limited, 8, Bouverie-street, E.C. 4. Price 45s.

Forecasting Weather. By Sir Napier Shaw. Second edition. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 36s. net.

Electrical Engineering Practice. By J. W. Meares and R. E. Neale. London: Chapman and Hall, Limited, 11, Henrietta-street, Covent Garden, W.C. 2. Price 25s. net.

L'Industrie du Gaz, Traitement des Produits et Sous-produits. By René Massé and Auguste Baril. Paris: Gauthier Villars and Cie, 55, Quai des Grandes-Augustins.

The Law and Practice of Town Planning. By Sydney Davey and Francis C. Minshull. London: Butterworth and Co., Limited, Bell-yard, Temple Bar, W.C. 2. Price 25s. net.

Sexton's Pocket-book on Boilermaking, Shipbuilding, and the Steel and Iron Trades in General. Revised by P. W. McGuire. London: E. and F. N. Spon, Limited, 57, Haymarket, S.W. 1. Price 6s. net.

The History and Progress of Metallurgical Science.*

By SIR ROBERT HADFIELD.

PAST GREAT MEN IN BIRMINGHAM AND DISTRICT (*continued*).

Watt (1736–1819).—When thinking of the great Engineers of the past in Birmingham, the name that rises first and most prominently before us is that of James Watt, whose portrait is shown in Fig. 7. The fame of Watt's great work in the development of the steam engine is world-wide. His discovery of the method of condensing steam in a vessel entirely separated from the cylinder occurred in 1765. He took out his first patent in January, 1769, and this was renewed by Act of Parliament in 1775. Later, in 1778, came his engine on the expansion principle, and his double-acting engine in 1781. In these days of rapid progress it may be interesting to state that James Watt once called Richard Trevithick a murderer, for proposing to operate boilers at the "dangerous" pressure of 60 lb. per square inch. To-day at Rugby a plant is, I believe, being designed under the Benson system for a minimum boiler pressure of 3200 lb. In view of your recent Centenary celebrations of Watt and his work, it is not necessary for me to add anything further here. The Institution of Civil Engineers has honoured his memory by founding the Prize of the Watt Gold Medal, which is awarded annually. The large statue in Westminster Abbey, "James Watt, the Improver of the Steam Engine," was by Chantry, the Sheffield sculptor, whose body was buried at Handsworth.

FIG. 7—JAMES WATT (1736–1819)

Boulton (1728–1809).—Watt was ably assisted by Matthew Boulton, and later by William Murdoch. Boulton, whose portrait is shown in Fig. 9, was born in 1728, and started the famous Soho Works in 1762. James Watt joined him in partnership in 1769, and Murdoch came into the firm about 1777. This wonderful triple combination gave us the steam engine, gas lighting, and other industrial developments. William Brunton, the inventor of the first mechanical stoker, was also one of the Soho group of Engineers. His work in this field and, indeed, the whole early history of mechanical stokers, is discussed in "Mechanical Stoking" (Pitman's) by Mr. David Brownlie, who has devoted much time to the study of the subject.

Murdoch (1754–1839).—William Murdoch, whose portrait is shown in Fig. 8, was born in 1754 at Lugar, Ayrshire. He was the son of a small farmer and, as rumour insists, supposed to be of Flemish extraction. After leaving his native village in 1777, he obtained a situation as mechanic with Boulton and Watt. In 1792 he lighted his house and office at Redruth, Cornwall, with gas, and in the same year erected his first gasometer at Birmingham, which gave continuous service from this time until 1911—that is, for nearly 120 years. This still stands, though in partial ruin, at the works of Messrs. Avery, Soho Foundry, near Birmingham. Until comparatively recently the gasholder was intact and was used for the storage of Dowson gas. In 1798 Murdoch left Cornwall to take up a prominent position at the Soho Works, where he constructed gas-making apparatus on a larger scale; this included lighting their principal building, and various new methods were practised for washing and purifying gas. Murdoch designed the Gasometer whilst some of the Gas Companies in London were struggling with the use of gas balloons to store the gas. This was the forerunner of the modern gasholders, some of which have reached huge proportions, as in the case of that of the Gas Light and Coke Company in London, which has a diameter of 300ft. and a capacity of 12,000,000 cubic feet. In 1808 he read a paper before the Society of Arts with regard to his installation of gas lighting at the Phillips and Lees Cotton Mill in Manchester, containing some 900 gas burners. For this he was awarded by the Society the Rumford Gold Medal.

FIG. 8—WILLIAM MURDOCH (1754–1839)

In a paper on "Corrosion of Ferrous Metals," read before the Institution of Civil Engineers in 1922, I referred to the work of Murdoch and the original Gasometer erected by him in Birmingham in 1792. An analysis of the iron used in its construction, taken from a specimen furnished to me by the courtesy of Messrs. W. and T. Avery, was made at the Laboratory of my firm and showed the following composition:—

C.	Si.	S.	P.	Mn.	Cu.	Fe.
.04 ..	.28 ..	.045 ..	.550 ..	.07 ..	.02 ..	98.9 per cent.

The total impurities in the iron—that is, C, Si, S, P, Mn, and Cu—amounted to .99 per cent., which hardly brings it under the category "Pure Iron." Yet, as already mentioned, the Gasometer in question was at work until quite recently, satisfactorily resisting the corrosive effect of wind and weather.

Priestley (1733–1804).—Turning now to the study of Chemistry, Dr. Priestley's name must be remembered. He was born in 1733 at Fieldhead, Birstal, near Leeds, which had been occupied by his father and grandfather, and afterwards by his sister, Mrs. Crouch. He lived at Warrington from 1761 to 1768, in Leeds from 1769 to 1773, in Birmingham from 1780 to 1791, and then went over to the United States in 1794. His last letter written in England was dated February 7th, 1794. He arrived in New York on June 4th of the same year and died in that country in February, 1804. A statue to his memory was unveiled by Professor Huxley at Birmingham in August, 1874. Priestley had a meeting with Dr. Benjamin Franklin, during one of his visits to London, which caused him to take up the study of Electricity, and eventually to write a history of the knowledge then existing on that subject. This, together with several new experiments on Electricity, won him not only outside reputation, but resulted in his election as Fellow of the Royal Society in 1766. It is interesting to note that Benjamin Franklin was one of Priestley's proposers when his name was submitted to the Royal Society for election. Priestley, whose portrait is shown in Fig. 10, was an extraordinary combination of Theologian, Philosopher, and Chemist. Somewhat singular to say, it was not until 1780 that he abandoned the subject of Electricity for Chemistry.

By his great discovery of Oxygen, Priestley made for himself an undying name. Whilst this contained the germ of the modern Science of Chemistry, yet, owing to his blind faith in the phlogistonic theory, the significance of his work was to some extent lost upon him. The first announcement was made by him in a letter dated March 15th, 1775, which was read at the Royal Society on May 25th of that year. Priestley's account of the discovery of Oxygen is given in his own words as follows:—"Having procured a burning lens, I proceeded with great alacrity to examine by the help of it, what kind of air a great

* An address delivered before the Birmingham University Metallurgical Society on Tuesday, October 30th, 1923. Abridged.

variety of substances would yield, putting them into vessels filled with quicksilver, and kept inverted in a basin of the same. After a variety of other experiments, I endeavoured to extract air from mercurius calcinatus *per se*; and I presently found that, by means of this lens, air was expelled from it very readily. Having got about three or four times as much as the bulk of my materials, I admitted water to it, and found that it was not imbibed by it. But what surprised me more than I can well express, was that a candle burned in this air with a remarkably vigorous flame. I was utterly at a loss how to account for it." His experiments showed him that this air "had all the properties of common air, only in much greater perfection," and he called it "Dephlogisticated air," regarding it simply as very pure ordinary air.

It was in Paris, however, in October, 1774, where

FIG. 9—MATTHEW BOULTON, F.R.S. (1728-1809)

Priestley, according to his account, spoke with the great French chemist, Lavoisier, of the experiments he had already performed, and those he meant to perform, in relation to the new Gas. Fifteen years later Priestley declared specifically that he had told Lavoisier of his experiments during this visit to Paris. This fact is mentioned because at one time it was thought that Lavoisier might have been the first to make the great discovery, but this was not so.

Apart from his work in connection with the discovery of Oxygen, Priestley also discovered Carbon Monoxide. His invention of the Pneumatic Trough was of much service, enabling him not only to discover new gases, but to investigate more fully the properties of many already partially known.

There were serious riots in Birmingham in 1791,

FIG. 10—JOSEPH PRIESTLEY, F.R.S. (1733-1804)

probably meant to commemorate the French Revolution in 1789. These partly took the form of an attack, amongst many others, upon Priestley's house at Fair Hill. Fortunately, the Doctor was able to get away in safety, but his house was completely gutted. In this connection I present an interesting picture in this Address (Fig. 11) showing the mob at work. This has been obtained from a valuable set of memoirs referring to Dr. Priestley's life and work, got together by Dr. James Yates, F.R.S., and now in the Royal Society Library. It may be mentioned that Mr. Samuel Tertius Gallon afterwards purchased the site, and rebuilt the house, naming it "The Larches."

A local account of the destruction is set forth in the following words:—"They destroyed an apparatus of philosophical instruments, and a collection of scientific preparations for ascertaining the powers and extending the knowledge of Nature, of such number and value as perhaps no individual except Dr. Priestley could have been deprived in any day or country."

An interesting letter addressed to the Town of Birmingham was written by Dr. Priestley regarding this mob attack on July 19th, 1791, in the following terms:—

July 19, 1791.

To the Inhabitants of the town of Birmingham.
My late Townsmen and Neighbours,

You have destroyed the most truly valuable and useful apparatus of philosophical instruments that perhaps any individual, in this or any other country, was ever possessed of, in my use of which I annually spent large sums with no pecuniary view whatever, but only in the advancement of Science, for the benefit of my country and mankind. You have destroyed the Library corresponding to that apparatus, which no money can re-purchase, except in course of time. But what I feel far more, you have destroyed manuscripts, which have been the result of the laborious study of many years, and which I shall never be able to recompose; and this has been done to one who never did, or imagined, you any harm.

In this business we are the sheep and you the wolves. We will preserve our character and hope you will change yours. At all events we return you blessings for curses, and hope that you shall soon return to that industry and those sober manners for which the inhabitants of Birmingham were formerly distinguished.

Yours faithfully,
J. PRIESTLEY.

An old proverb says: "The ship that carries most sail is most buffeted by the winds and storms." It was so with Priestley; his mental capacity was great, but most severely was he buffeted specially in the later portion of his career. Nevertheless, he manfully overcame all obstacles and the World is greatly indebted to him for the most valuable developments he helped to bring about, including his important discovery of Oxygen, an Element now being used on a large scale for many purposes.

FIG. 11—DR. PRIESTLEY'S HOUSE AND LABORATORY, FAIR HILL.
Destroyed in the Riots which took place on July 14th, 1791.
From a Picture sketched on the spot in the possession of Joseph Parkes

Percy (1817–1889).—Through the kindness of Professor Turner, I have been able to obtain some interesting information with regard to one of the noted Metallurgists of our time—Dr. John Percy, M.D., F.R.S., who was for so many years connected with Birmingham. His portrait is shown in Fig. 12. Some of my earliest studies of Metallurgy were made from Percy's excellent works, including those relating to both Ferrous and Non-Ferrous Metallurgy, Fuel, and other kindred subjects. His well-known and classic works were of the greatest service to many of us studying this subject some thirty or forty years ago. Percy went through a course of training at the University of Edinburgh, which he left in 1838, having gained many prizes. He then proceeded to Paris, where he took up further studies, which brought him in contact with some of the leading Chemists of his day. This developed a taste for Chemical Research, in which he was afterwards destined to acquire so high a reputation. Having completed his academical career in Paris, he travelled for a time, and on returning to England began to practise as a medical man at Birmingham. In 1839 he married his cousin Grace, the only child and heiress of John E. Percy (sometimes spelt Piercy), of Warley Hall, near Birmingham. The young couple took up their residence in that town, where Dr. Percy had been elected physician to the Queen's Hospital. He never entered on any general practice, but made some researches in physiology and pathology, which won for him considerable medical fame.

Percy, however, did not care to follow a medical career, and concurrently with his professional studies and practice, he conducted researches in Mineralogy and Metallurgy, including specially the constitution of crystallised slags. In these researches, which commenced in 1846, he had the co-operation of the late Mr. David Forbes—formerly Secretary to the Iron and Steel Institute—and Professor W. H. Miller, of Cambridge. Among the studies which these gentlemen took up, the more prominent were the alloys of Copper with Manganese and Nickel, the effect of Phosphorus on Copper, and the composition and qualities of coal. In his masterly Presidential Address, well worthy of being read even to-day, contributed to the Iron and Steel Institute in 1885—that is, forty years later—Dr. Percy, when referring to the problems connected with the appearance of silica in the slag of iron blast-furnaces, and to show his keen delight in matters metallurgical, mentioned that he had recently received what he characterised as "a superb specimen, more valuable to me than a mass of gold of equal weight; the sight of it affords me delight. I often look at this specimen, and every time with increasing pleasure." In 1877 he received the Bessemer Gold Medal of the Iron and Steel Institute.

Speaking personally, I was largely influenced to take up the investigation of Alloys of Iron with other Elements by my study of Percy's books, combined with the splendid work of the Terre Noire Company, France, on special steels, steel castings, and ferrous alloys, so well illustrated both by their exhibits and literature, at the great Paris Exhibition of 1878. The fascinating descriptions of the thousand and one experiments carried out by Percy could not fail to arouse interest and eventually bring to the mind of anyone carefully studying them the great possibilities of steel alloys. As Faraday's records show, his master mind was also attracted in this same direction. The early studies of these two great men have happily matured to the enormous benefit of the world at large. I consider it a matter of no little satisfaction and encouragement to have worked in this same direction.

Percy resided for eleven years in Birmingham, and it was in this city where he first became interested in Metallurgy, thus obtaining the experience which eventually, in 1851, led to his becoming the Lecturer on Metallurgy at the then newly formed Royal School of Mines, and Metallurgist to the Museum in Jermyn-street, which even to-day stands unrivalled in its wonderful contents relating to Mineralogy. Until that date no Professor of Metallurgy had been selected, though there had long been a crying want for such an appointment in this country, the natural wealth of which depends so much on its mineral resources and a correct understanding of how to win them from Mother Earth as well as to turn them into metals which are so important to meet the needs of modern mankind.

Percy was a man with astonishing energy and great genius. Several of his books are classic ones, and even to-day they are most useful for reference. He was lavish in his hospitality and most of his friends were connected with the iron and steel trade. He was much indebted to local ironmakers, including Blackwell, of Dudley; Dawes, of Bromford, and many others, for the data which he obtained and put forward in his books. His classic book *Metallurgy: the Art of extracting Metals from their Ores, and adapting them to various purposes of Manufacture*, was written

whilst he was Lecturer on Metallurgy at the Royal School of Mines. The first part was published at the end of 1861, and the second part in February, 1864. In his methodical way he dealt with the physical properties of iron, the mechanical properties of iron, and alloys of iron. He also covered the ground with regard to iron ores and their assay; direct extraction; blast-furnace practice; the production of malleable iron from cast iron. Separate chapters were devoted to steel, including the production of steel by the addition of carbon to malleable iron; by partial decarburisation of cast iron; and by fusion of pig iron with malleable iron. He dealt with the casting, the manipulation of steel, also its mechanical qualities.

To my mind, Percy rightly stated that the age of iron preceded the age of bronze. He admitted that there had not been much evidence of this collected, but pointed out that this was largely due to the fact that iron is rapidly corroded by oxidation, even in dry climates; whereas bronze is acted upon but slowly, even in moist climates. As an indirect confirmation of this Sir William Flinders Petrie, F.R.S., to whom I am sure all here present offer heartiest congratulations upon his recent Knighthood for the magnificent work done over such a long period of time in his studies in Egyptology, showed me a few months ago a small dagger-shaped knife, which he

FIG. 12—DR. JOHN PERCY, F.R.S. (1817-1889)

vouched for as dating back to the VI.–VIII. Dynasty, about 4000 B.C. But how comparatively few evidences there are on this point. The use of steel is attested by the mortuary furniture on many Anglo-Saxon graves. Many tombs of ancient times have revealed specimens of steel. The comparative rarity of the steel is explained by the indifference with which it has been regarded by archæologists. Many steels have been found accompanied by flints, the latter much worn by continued striking, and covered with oxide of iron, showing they had been in full use. These two examples further confirm Dr. Percy's belief as to the position in point of time of the Iron Age. I have dealt with this subject in several papers to our Scientific and Technical Societies, and will be glad to send copies to anyone interested. Percy gives full credit to Dud Dudley, of Tipton, and assigns to him the distinction of having first solved the important economical problem of the extraction of iron from its ores by means of pit coal.

Gore (1826–1908).—We now turn to one who was not a maker of Metallurgical products, but whose scientific researches and laboratory work make us much indebted to him; I refer to Dr. George Gore, F.R.S., whose portrait is shown in Fig. 13. Though born at Bristol in 1826, he had a long connection with Birmingham. If he had done nothing beyond writing his admirable book, *The Art of Scientific Discovery*, he would have made a name for himself by this alone. It is a work which, whilst now out of print and very scarce, well deserves to be re-issued, containing, as it does, such excellent precepts and guidance to those engaged in research work, whether purely scientific or technical. They apply to-day just as much as when he wrote them forty-five years ago. Such importance do I attach to Gore's views and advice, that in the Appendix of this Address there is given a full extract of the views he expressed, in 1878, on the general conditions and methods of research in Physics and Chemistry. The guidance there set forth should make the book be read by all younger men studying and engaged in research questions.

Gore left school at thirteen years of age and began work as an errand boy. At seventeen he was apprenticed to a cooper, and worked at that trade until he was twenty-one, meanwhile studying Science and making what experiments he could in his small leisure. He was keenly interested in electro-deposition, and probably his desire to pursue this subject is the reason why he came to Birmingham in 1851. He held classes on electro-plating and chemistry, and thus began his long career as a teacher in Birmingham. Later, he was appointed Science Master at King Edward's School, a post which he held for many years. Gore was also an ardent advocate of research. His well-known works on *The Scientific Bases of Morality; The New Scientific System of Morality; The Scientific Bases of National Progress*; and *The Art of Scientific Discovery* are of the highest importance. Finally, in 1880, an "Institute of Scientific Research" was founded by a few citizens in Birmingham; here Dr. Gore was installed, and worked for the rest of his life. He was elected a Fellow of the Royal Society in 1865; in 1877 he received the degree of LL.D. from the University of Edinburgh; and in 1891 he was given a Civil List Pension in recognition of his contributions to Science. He died on December 20th, 1908, when nearly eighty-three years of age. By his will his residuary estate was equally divided between the Royal Society and the Royal Institution for the purpose of assisting original scientific discovery. The share of the Royal Society, amounting to nearly £2500, has been invested as the Gore Fund.

In a paper on "A Momentary Molecular Change in Iron Wire," published in the "Proceedings" of the Royal Society, No. 108, page 260, January 28th, 1869, Gore described a singular phenomenon which he observed in the cooling of iron wire whilst searching for magneto-electric induction by sudden change of temperature of a magnet. The wire had been heated to a full redness whilst kept under a suitable degree of longitudinal tension by means of a spring attached to one of its ends. During cooling, and whilst still red hot, the iron gradually diminished in length, then suddenly elongated by diminution of cohesion, and finally contracted gradually, almost to its original length, during the remainder of the cooling process. A corresponding but reverse phenomenon did not occur during the process of heating the wire. Various other metals were similarly examined, but no such peculiar phenomenon was found.

In another interesting paper, "On the Molecular and Magnetic Changes of Iron, &c., at Different Temperatures," which appeared in the *Philosophical Magazine*, Vol. xl., July-December, 1870, he stated: "Mr. R. W. Fox (*Phil. Mag.*, 1835, Vol. ii., page 388) showed that cast iron in the melted state produces little or no effect upon a delicately poised magnetic needle placed near it during its cooling, solidification, and subsequent further cooling, until the solid metal acquires 'a cherry-red colour'; it then suddenly attracts the needle with great energy." Gilbert had many years before shown that a piece of soft iron at a bright red heat loses all ordinary signs of magnetism, and Faraday had demonstrated that wrought iron retains only traces of its ordinary magnetic capacity at that temperature. He concluded the particular research mentioned above by saying:—"The changes produced by heat in even so simple a substance as iron were so numerous in some of these experiments as to produce the impression that the metal was endowed with vitality."

Gore carried out many valuable series of experiments which are well worth consideration even to-day, specially on account of the wonderful power of observation he displayed, but there is no space in an Address of this kind to do more than briefly refer to them. Out of Gore's experiments sprung the still more important ones of Barrett, who discovered the property of recalescence in steel. These were further elaborated by the late Professor F. Osmond, the late Sir William Roberts-Austen, Professor H. le Chatelier, Dr. J. E. Stead, Professor J. O. Arnold, Dr. W. Rosenhain, Professor H. C. H. Carpenter, and others. From this combined research work have developed many remarkable applications to the Metallurgy of iron and steel. Other metals, with the exception of nickel and cobalt, show very little change under heating and cooling, and the changes which do occur in these two metals are in no way so pronounced as in iron.

Siemens (1823–1883).—Siemens first visited England about 1842 in connection with a new Electric Process of Gilding and Silvering. His success on that occasion, when having been paid a considerable sum by Messrs. Elkington he was able to return home a comparative Crœsus, led to a second visit and a further receipt of £1200. This took place in the spring of 1844, and from that time England became his home.

As is well known, Siemens did his most notable work in practical Electricity and the application of heat to Industrial Processes. In 1853 he read a paper to the Institution of Civil Engineers "On the Conversion of Heat into Mechanical Effect." Sir Dugald Clerk, F.R.S., has gone so far as to say:—"Here for the first time we find the engineer guided by an intelligible principle, and that of all the engineers who spoke on that occasion, Siemens alone seemed to thoroughly apprehend the value of Joule's results." Sir William Siemens' knowledge of scientific principles enabled him to grasp the importance of the invention of the Regenerative Furnace by his brother, Mr. Friedrich Siemens. This invention was made in 1856. Experiments made with the Furnace were speedily followed by a practical application, notably at the glass works of Messrs. Chance in Birmingham.

It was in 1861 that the two brothers patented their Gas Producer for use in conjunction with the Regenerative Furnace. The Siemens Steel Works were started in Birmingham in 1866, and two years later the Landore Siemens Steel Company began work at Swansea. This is specially mentioned because it was from the Landore Works that Siemens supplied the material for the first of our steel-built Men-of-War, H.M.S. Iris and Mercury. It will be remembered that Sir Nathaniel Barnaby asked the Steel Makers of Great Britain to produce a steel of remarkable quality for shipbuilding purposes. One result of the success of this great development by Siemens was the rapid extension of the use of steel for shipbuilding. Prior to 1877 only 1 per cent. of our ships were built of steel, but at the time of Siemens' death, only six years later, the proportion had risen to 14 per cent., and, as you all know, by the end of the century practically every ship was of steel. Sir William Siemens, F.R.S., received the Bessemer Gold Medal of the Iron and Steel Institute in 1875, and was also President of that body from 1877 to 1879.

Greenwood (1846–1905).—Professor W. H. Greenwood, who was born at Manchester and received his scientific training at the Owens College there, and at the Royal School of Mines and University College, London, came to Birmingham in 1885 and for many years held a most important position with the Birmingham Small Arms and Metal Company. In 1869 he obtained a Senior Whitworth Scholarship, and became Assistant Manager at the Whitworth Works in Manchester in 1871. He went to Russia in 1875 as Chief Engineer to the Government Ordnance Works at Obouchoff, near St. Petersburg. On returning to England in 1880 he became connected with the Landore Siemens Steel Company, and five years later accepted the Professorship of Mechanical Engineering and Metallurgy in the University College, Sheffield—that is, before the foundation of the University. His Manual on Metallurgy and numerous papers are well known and of great interest in this particular branch of Science.

Kapp (1852–1922).—An account of those who have so greatly helped Scientific Training and Research in Birmingham would not be complete without a reference to the late Professor Kapp, who was the first Professor of Electrical Engineering in the University from 1909 to 1919. I was fortunate enough to have the pleasure of knowing him, not intimately, but through important correspondence which passed between us.

To quote from that excellent magazine of your University, *The Mermaid*, "Kapp was no mere Commercial Engineer, but a forceful and resolute real presence, not afraid of declaring that which in the real soul of him he feels to be true. A rugged and even despotic temperament, impatient of triflers; yet withal that greatest of God's creatures—a sincere man. To carry out the ideal of his work he wore

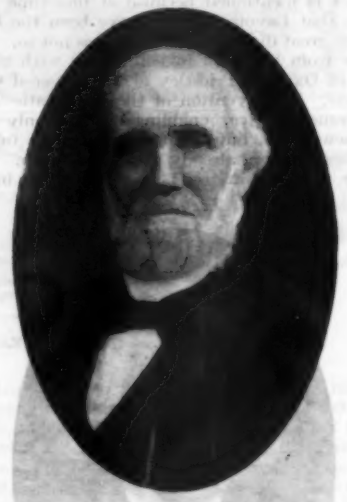


FIG. 13—DR. G. GORE, F.R.S. (1826-1906)

himself out, but meanwhile endowed some of his students, his books, and his inventions with his own life."

Other Names.—The pioneers already mentioned by no means exhaust the list of great men who have been associated with this city. If space had permitted, there is much that might be said concerning John Bright and Joseph Chamberlain—men who belong to the Empire and were two of its great builders; Josiah Mason, to whose great interest in education Birmingham owes so much. George Elkington, whose important work has been so well described by Mr. R. E. Leader, of Sheffield, in an interesting paper entitled "The Early History of Electro Silver Plating," read before the Institute of Metals in September, 1919; also Philip Henry Muntz, G. Dawson, the Tangyes, the Kenricks, and many others.

I should have liked to include the name of the late Mr. J. D. Ellis as a Birmingham man. He, however, left the city in 1854 for Sheffield, where he made a name famous in the annals of Metallurgy and its developments. By his encouragement of scientific methods and research his son, Sir William Ellis, G.B.E., the President Elect of the Iron and Steel Institute for next year, is worthily continuing his father's work.

(To be continued.)

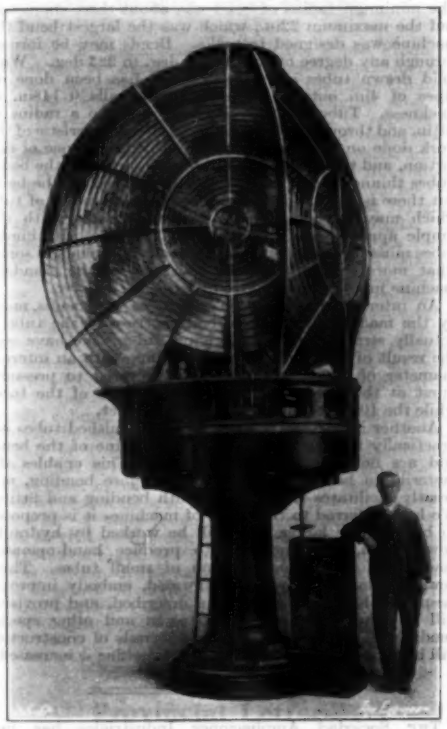
Lighthouse Apparatus for Australia.

On the occasion of a recent visit to the works of Chance Brothers and Co., Limited, at Smethwick, near Birmingham, we had an opportunity of seeing at work the apparatus for a new lighthouse—shown in the illustration below—which is to be erected on Eclipse Island, Western Australia.

The light is of the first order, and will enable mariners going eastward to pick up Eclipse Island after losing the Cape Leeuwin light—the most westerly of Australia—and thus get a lead into the port of Albany. The beam from the new lens will be of about 1,167,000 candles, which will give a luminous range of from 90 to 95 miles in clear weather, while the light will be visible by an observer 55ft. above sea level at a distance of 30 miles. The lantern will be erected on a tower which will bring the focal plane to a level 396ft. above sea level.

The optical apparatus gives a triple flash every 20 seconds, and takes the form of three panels with a dioptric mirror. The centre one of the three panels is slightly narrower than the two wing panels, but the amount of light which it emits is brought up to the same value by the mirror behind. It was noticeable, when we saw the light at work, that although the first and third beams of light are distinctly larger and of different shape to the second beam, all their intensities were practically equal.

The light is produced by a Chance incandescent oil burner, with an Autoform mantle, 85 mm. in diameter. These Autoform mantles are made of silk, and are quite flexible before they are put in service. They can consequently be carried about packed together in a box—a great convenience as compared with the old collodion type mantles, which had to be packed individually in bulky tin canisters. When the Autoform mantle is put upon the burner, the flame blows it out into shape, and it automatically takes a form best suited to utilise the heat of the burner. We understand that the intrinsic brightness



LIGHTHOUSE APPARATUS FOR AUSTRALIA

of the new mantles is about 70 per cent. higher than that of the old type.

The revolving portion of the apparatus weighs 7720 lb., and is carried by an iron float in an annular trough of mercury, but the float and trough are made so nearly of the same dimensions that it only requires some 386 lb. of mercury to float the whole load. The arrangement naturally reduces friction to a minimum, and the mass of, say, 3¼ tons can easily be set in motion with the pressure of one finger.

In order that the mercury trough may be cleaned out, it is so arranged that it can be lowered, while the weight of the revolving part is carried on rollers. It will be noticed that the main standard of the light has a big screw thread cut upon it. The trough is screwed on this thread, and can thus be raised or lowered readily.

The motive power is provided by clockwork in the case beside the man in the engraving, which is driven by a falling weight. The weight requires re-winding every two hours, which ensures that the attendant shall not leave his post for long. The lantern in which the light will be installed is 14ft. 9in. in internal diameter, and has circular glazing fitted in helically inclined gun-metal framing. The roof is of copper, and the base of cast iron lined with sheet steel. Elaborate arrangements are made to provide ventilation without draughts, and galleries run round inside and out to provide access for cleaning the glass.

The apparatus was ordered by Mr. J. F. Ramsbotham, Director of Lighthouses, Commonwealth Lighthouse Service, Melbourne.

We had the good fortune while at Smethwick to see at work another class of lighthouse apparatus. This one is to be erected at the port of Lagos, West Africa, and consists of a third-order double-flashing light on a mercury pedestal. It will replace an old fixed light. This apparatus has been designed by Mr. D. W. Hood, Engineer-in-Chief to the Trinity House, and differs in some of its mechanical details from the Australian light, while the lenses are naturally of a different type to produce the double flash.

THE INSTITUTION OF AUTOMOBILE ENGINEERS.

The new offices of the Institution of Automobile Engineers at Watergate House, York-buildings Adelphi, W.C 2, are adjacent to the old York Water Gate, which marks the margin of the river before the construction of the Embankment. The Water Gate, which was designed by the famous architect, Inigo Jones, was constructed in 1626 as an approach from the Thames to York House, the residence of George Villiers, first Duke of Buckingham. The mansion was demolished about 1673, but the gateway has happily been preserved and forms an interesting reminder of the times when the north bank of the Thames was lined with the residences of English noblemen.

The new offices of the Institution occupy the whole of the second floor of Watergate House, which is a modern, well-appointed building within two minutes walk of the three Charing Cross Stations, and is, therefore, easily accessible from all parts. The council room has a frontage on the Embankment Gardens, whilst another room, immediately behind, has been fitted up as a library and lounge for members who are cordially invited to make use of it for reading, writing, or meeting friends. Telephone facilities are also provided. The remainder of the suite comprises the secretary's and general offices.

SIXTY YEARS AGO.

In an article printed in our issue of November 6th, 1863, entitled "The Friction Dynamometer," some interesting information is to be found regarding the origin and development of brakes employed for measuring the horse-power of engines. It would appear that the friction brake was not, as is still commonly supposed, invented by de Prony—the favourite engineer of the first Napoleon—but that when in 1821 he applied it in practice and explained it mathematically, he had been forestalled in the conception of the idea by M. Hachette in 1811, and by M. Gingenobre in 1815. De Prony's brake was first used for the purpose of providing Louis XVIII. with a report "on the old and new engines of Chaillot." This form of brake was adopted in Great Britain by the Royal Agricultural Society as a "force resister" for measuring the "dynamic effect" of agricultural prime movers and continued to be used until after 1850. Round about 1854, the Society adopted for its trials a form of brake invented by Mr. Balk, at one time understood to be associated with Ransomes and Sims, of Ipswich. This invention, however, did not, it is recorded, act satisfactorily, and its use "led to disputes amongst the eager competitors." Subsequently, the Society evolved a form of brake embodying improvements originated by Mr. J. G. Appold—a gentleman whose name is associated also with the development of the centrifugal pump—and by Clayton and Shuttleworth, of Lincoln. It is strange to find that even in 1863 the friction dynamometer was used in England only by agricultural engineers, a fact to which was attributed "the comparatively high dynamic efficiency of the portable engine." In the course of the article from which we have quoted, we find references made to several other inventors who endeavoured to improve the friction brake. White, in his "Century of Inventions," published in the early years of the nineteenth century, illustrated a friction brake and described it as a "real tribometer, or measurer of friction." He seems, therefore, to deserve a place of honour in the history of the evolution of this device. In 1829, Fourneyron invented a modification of the de Prony brake for measuring the output of his water turbine, and about the same time M. T. Barrois and Dr. Alban also brought out improvements. Dr. Alban, it would appear, deserves attention at the hands of the modern historian of engineering. He is described as "the prophet of high-pressure steam, the author of the well-known work on the high-pressure engine, and the enthusiast who, when doctor to a hospital, was turned away for converting the *lavement* syringes into small steam engines."

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

PORT OF LONDON: IMPROVEMENTS.

Sir,—In The Engineer of August 3rd, 1923, Vol. CXXXVI., No. 3527, I note the welcome news that the Port of London Authority has decided to make radical improvements in Tilbury Docks. I well remember in 1914, when the British Association was in Melbourne, discussing the problem of the London docks and describing my personal experiences when embarking there, characterising it as that one went on board very much in the same way as the animals went aboard Noah's Ark—"two by two," and at the same time contrasting the inadequate arrangements with those provided at the port of Liverpool.

(2) Your paper shows, Figs. 1 and 2, the former scheme having been superseded by the latter, although no convincing reasons are given for the alterations. The superseded scheme, to my mind, possesses many points of superiority over the approved one. For example, the dry docks and the new entrance have been brought down to the head of the main branch dock, and are thus in the best position for serving the proposed new dock and the existing docks, a point of considerable value. In addition, the land of the least value for shipping is utilised in a useful manner. The direction of the entrance and the placing of it in the right angle junction of the proposed and existing main dock, gives an admirable lead for vessels leaving or proceeding to the old docks, and at the same time provides a sufficient turning basin for ships entering or departing from the new dock.

(3) On the other hand, however, by placing the new entrance two-thirds of the way down the main dock, as is shown on the accepted plan, the railway and cartage communications for the valuable berths on two-thirds of the west side and all on the south side are severed, and it will make the traffic problem most costly and difficult to deal with, necessitating expensive bridges over the lock and interferences when shipping is using the lock. It would seem that the severing of the south berths is common to both schemes; but, obviously, it is important to have as little traffic to deal with over the bridges as possible. The turning basin for large ships in the main dock is bad and inadequate, and under adverse weather conditions it may necessitate the moving of shipping in the vicinity. The same remarks apply to ships entering and leaving the proposed dry dock, particularly as such vessels are always light and high out of the water. In addition to this, the placing of the dry dock at the end of the new dock will preclude any further extension in that direction. This aspect should not be overlooked, as the capital cost of entrance and dry dock will require considerable quayage, or available earning capacity, in order to justify their existence.

(4) On the face of it, I can see no justification for the proposed alteration of schemes, and can only surmise that uncertain foundations have led to the alteration. It would be of interest to know what has actuated the change.

J. F. Ramsbotham, M. Inst. C.E., M. Am. Soc. C.E.

Melbourne, Australia, September 24th.

THE PIECEWORK SYSTEM.

Sir,—I have read Mr. J. Taylor's letter on the subject of piecework, but I find in it only a diatribe against the application of the piecework system. Not a word against the principle of the system.

It is, I think, acknowledged by all thinking men that to maintain our position in world trading we must have increased production, and this increased production cannot be obtained without the workman being given some share in the fruits of his increased effort. This can only be done in two ways, viz., by payment by results, or profit sharing; the latter alternative can be dismissed, as in many instances there would be no profits to share, and the workman, after putting forward his best efforts, would be badly left.

One of the curses of the application of the piecework system is that up to about ten years ago—generalising—prices were fixed in a very haphazard fashion by the foreman in charge. He had nothing to base his price on, except what had been paid before for a somewhat similar article, or, he looked at the job, and then bartered with the workman for the price. It then very often depended on whether workmen were scarce or plentiful, what price was decided on. Another cause for complaint was that in most works a man was limited to time and a-quarter. This bred the complaint that Mr. Taylor makes of good prices and poor prices; in fact, I have known cases where a workman, having a good price for a running job, has been compelled to run other jobs in for nothing.

But the last ten years, and their experiences, has cleared the eyes of the vast majority of managements. It is recognised that piece rates must be scientifically calculated according to the capacity of the machine and average ability of the workman, and it may surprise Mr. Taylor to know that in the majority of cases the machine is the main factor.

Very few workmen know, or wish to know, the full capacity of the machines they are working; very few workmen realise how long a minute and an hour is, and how many of them be allows his machine to waste. Let him stand the full two minutes on Armistice Day, and think how much work his machine could have turned out in that time, and then realise that there are thirty two minutes in every hour.

The only satisfactory method of fixing piece rates is to calculate each operation from the drawing, to the speeds and feeds of the machines, with proper allowances, see that the machine is properly equipped and that the piece to be machined is reasonably to the drawing. If not reasonable, additions should be made to the price, and the additions charged back to the supplier.

If this method of fixing prices was adopted generally, and I have reason to think that it will be, there will be very little dissatisfaction amongst the genuine workers.

The main point for all parties to remember is, that a square deal will induce a square deal in return.

Superintendent of Production.

November 6th.

MARSHALL, SONS AND CO., LIMITED, AND VICKERS LIMITED.

Sirs,—We shall esteem it a favour if you will kindly publish in an early issue of your journal a paragraph stating that we emphatically deny the report—circulated by certain sections of the lay Press—that Vickers Limited have taken over or acquired this firm. The report is absolutely without foundation.

Marshall, Sons and Co., Limited,
Herbert J. Marshall,
Managing Director.

Gainsborough, November 2nd.

EDUCATIONAL INTELLIGENCE.

Institution of Naval Architects.—The following scholarships will be offered for competition in 1924:—Naval architecture: "Institution of Naval Architects" (£130 per annum); "Beardmore" (£150 per annum), and the "Fairfield" (£150 per annum). Marine engineering: "Weir" (£150 per annum), and "Yarrow" (£100 per annum). The scholarships are open to British apprentices or students, and are tenable, subject to the regulations governing each scholarship, for three years at Glasgow University—with which (for marine engineering scholarships only) is affiliated the Royal Technical College, Glasgow—Durham University, Armstrong College; Liverpool University; Royal Naval College, Greenwich (for naval architecture scholarships only), and the City and Guilds (Engineering) College, Imperial College of Science and Technology, London (for marine engineering scholarships only). Full particulars may be obtained from the Secretary, Institution of Naval Architects, 5, Adelphi-terrace, London, W.C. 2.

A New Tube Bending Machine.

THE process of making bends in iron and steel tubes is one which is of interest to every engineer, since it forms an important part of the work of any engineering shop or shipbuilding yard. In the method which is commonly employed, the tube is first filled with a material, such as sand, which, owing to its incompressibility, allows the tube to be bent without collapsing. The process of filling a long tube with sand is a tedious one, and much ingenuity has been spent on sand filling and shaking-down machines. After it is filled the tube is raised to a working heat to reduce its rigidity, and the bend is then made round pins, formers, or sheaves, the necessary bending force being applied by hand, or mechanical or hydraulic means. The process we have described is both lengthy and costly, and often considerable extra time is spent on dressing the bend after it has been made.

Machines for cold bending are used to a limited extent in pipe-bending shops, but they have the disadvantage that a different former or sheave is required for each radius, which means that a large number of auxiliary parts must be carried, while considerable time is spent in setting up the machine, particularly if there is not much repetition work, and the size of radius is constantly being changed.

A new type of tube-bending machine, which has been built under the patents of Mr. C. R. H. Bonn, of Glasgow, by Hugh Smith and Company, Limited, of Possil Park Engine Works, Glasgow, is claimed to overcome most of the disadvantages we have mentioned. It has already undergone prolonged and successful tests, and will, we understand, shortly be put on the market in the form of a series of standard machines of different capacities, which will be built for both hand and hydraulic operation.

The illustrations—Figs. 1 to 3—accompanying this article show the experimental machine. Its distinguishing features are that steel, iron, and other metal tubes can be bent cold without filling and without formers, the only tools required being a slipper and a set of grips and mandrel heads for each bore of tube, which parts, the makers claim, are simple and robust in construction. Fig. 1 shows the machine with a 4in. steel tube in position ready for bending. In the foreground will be seen the pipe grip, the housing of which is mounted on a sliding saddle. This saddle is carried on the top part of a revolving arm, which is indexed to show the angle through which it is turned. Both the saddle and arm may be moved in a direction relative to the centre of the machine, adjusting screws being provided which fix the radius of the bend. Opposite the saddle is a head carrying a sliding slipper arm, also adjusted by a screw, the purpose of the slipper being to hold the tube tightly against the bending rail.

The power required to bend the tube is furnished by a hydraulic ram carrying an upper steel trough with an end stopper which, resting against the end of the tube, carries it forward. The position of the stopper may be varied by means of slots milled on the sides of the supporting trough. Immediately in front of the ram is an auxiliary grip which serves to keep the tube in alignment, and prevents it from moving either vertically or horizontally. Inside the tube there is placed a mandrel, the head of which lies in the interior at the region of bending, its rear end being anchored to the crosshead of the withdrawing ram, which is fixed behind the driving ram—see Figs. 2 and 3.

When the tube is in position—as shown in Fig. 1—the required radius having been fixed, the stopper is made to press against the end of the tube. After this has been done, the internal mandrel is drawn into position and fixed, the grips secured and the slipper arm screwed up so that the tube lies flat against the bending rail. The bend is then formed by advancing the end stopper by means of the hydraulic driving ram, until the index or the end post shows that the head has travelled through the required degree of arc. The mandrel is now withdrawn from the tube by the ram to which it is attached, the grip opened and the slipper arm released. After these operations have been carried out, the bent tube may be removed or another and following bend made by re-setting the mandrel, adjusting the radius screws if required, re-gripping the tube, and tightening the slipper. All this can be done without removing the tube from the bed of the machine.

The time taken for making a 180 deg. bend at 10¼in. radius with a 4in. diameter steel tube, is, we learn, about ten minutes for the first bend and five minutes for following or repetition bends. The necessary setting up is done quickly and in a simple manner, and no change of tools is required for different radii bends when the same bore of tube is being worked. Tests made indicate that there are no limits to the size of tubes which may be bent on this principle and that the only possible sources of failure are lack of sufficient ductility in the metal, or imperfections in the material from which the tubes are made.

The machine described was built primarily as an experimental machine, and it has, we understand, produced excellent bends in steel tubes of both steam and water quality in sizes varying from 2in. up to 5in. in diameter. The minimum radius of bend was about three diameters and the maximum 22in., which was the largest bend the machine was designed to make. Bends may be formed through any degree of arc from 0 deg. to 222 deg. With solid drawn tubes satisfactory work has been done on pipes of 4in. outside diameter, with walls 0.148in. in thickness. Tubes of this size were bent to a radius of 10¼in. and through 180 deg. of arc. A characteristic of the work done on this machine is the general absence of distortion, and the tube is left full bore throughout the bend. Tubes thinner than those already mentioned can be bent, but there is a limit of thinness for each diameter of tube which may be bent to the minimum radius with the simple appliances of the standard machine. If thinner tubes must be bent then minimum radius appliances somewhat more refined than those in use on the standard machine have to be employed.

An interesting point with regard to the bends made by the machine is that the bent portion of the tube is actually stronger than the original tube. We have seen the result of a test made on a 4in. pipe with an internal diameter of 3.6in., which, when subjected to pressure, burst at the weld on the straight portion of the tube, while the 10¼in. radius part remained intact.

Another important point is that the finished tubes are practically true to the designed centre line of the bend, and are not stretched in any way. This enables the material to be cut exactly to size before bending, and greatly facilitates the speed of both bending and fitting. We have referred to the series of machines it is proposed to build. The larger sizes will be worked by hydraulic power, and it is intended to produce hand-operated machines for the manipulation of small tubes. These new machines will, we are informed, embody improvements in the machine we have described, and provision will be made for making expansion and other special bends, while the control gear and details of construction will be arranged so that the speed of working is increased.

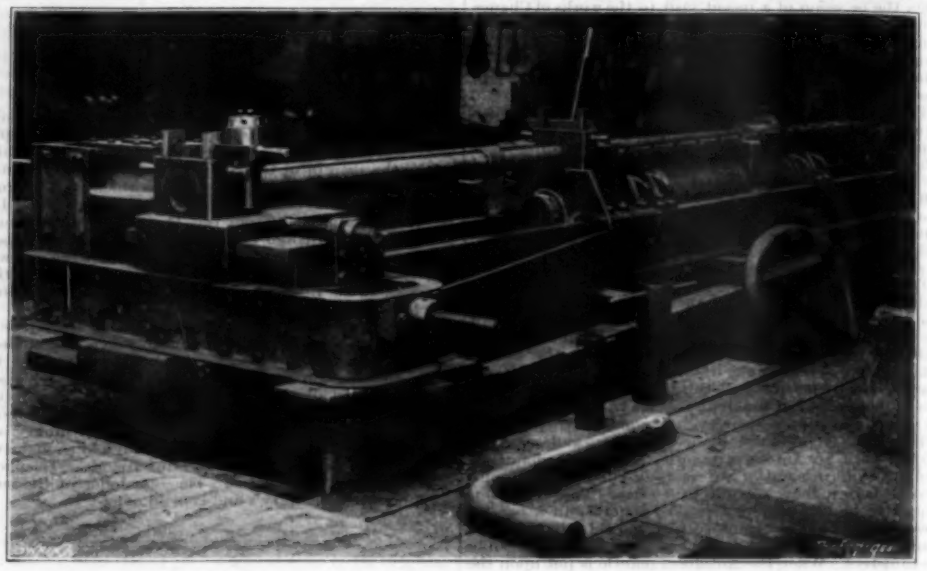


FIG. 1—BONN TUBE BENDING MACHINE WITH TUBE READY FOR BENDING

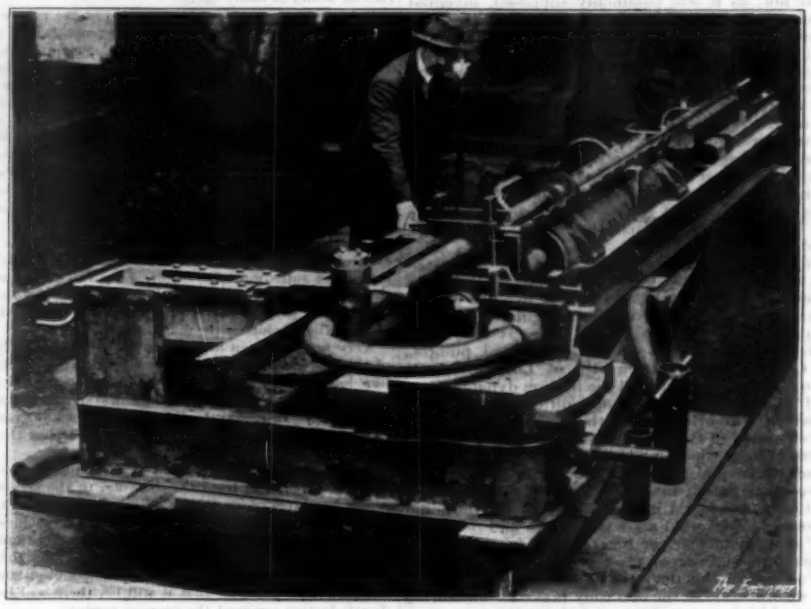


FIG. 2—FINISH OF A 180 DEG. BEND AT 10·5 INCHES RADIUS

FIG. 3—SIDE VIEW OF TUBE BENDING MACHINE SHOWING HYDRAULIC OPERATING GEAR

THE Sociedad Ampliaciones Industriales has just obtained a concession for the utilisation of hydraulic force on the river Ara with a flow of 5000 litres a second—just over 12,700 cubic feet per minute. This concession, which is granted for a period of seventy-five years, affects the communes of Boltana, Abella, Janovas and Rinas.

PROPOSED RAILWAY ACROSS THE SAHARA.

Further details are now available regarding the announcement that a Bill will shortly be laid before the French Parliament in connection with a proposed railway line across the Sahara. The matter has become one of greater urgency as the result of the passing of the new military law providing for the recruiting of 280,000 native troops every year. The greater number of these troops will be drawn from Africa, and the question of their transport has now naturally arisen. The Secretariat-General of the Supreme War Council considered the possibilities of the realisation of a trans-Saharian railway; the Secretary-General of the Ministry of Public Works drew up a report, which was approved by the War Council, and this report was then submitted to the Supreme Council of National Defence, which, under the presidency of M. Millerand, accepted its conclusions, including the suggested route. Starting from Oran, the line will pass through Colomb-Bechar, Beni Abbes, Adrar, Ouallen, Tessalit and Bourem to Ouagadougou, south of the Niger, the point which it is proposed to make a junction for the French African lines. This is the route to be followed by an endless track car mission, which it is proposed to send out shortly, and which is to explore the desert from Colomb-Bechar to Bourem, a distance of 1800 kilom's., with a view to the establishment of an aeroplane service.

It is understood that the Ministry of Public Works, as a result of the decision of the Supreme Council of National Defence, approached the P.L.M. Railway Company, which already controls the Western Algerian Railway system, and that the company has replied by placing in the hands of M. Le Trocquer an application for a concession, regarding which an agreement has now, it is said, been reached. The building of the line, it is estimated, will take seven or eight years; it will provide not only a strategic railway, but also an outlet for African products.

FIR VERSUS PINE TIMBER.

Extensive comparisons made by the Forest Products Laboratories of Canada, based upon experimental investigations undertaken both in Canada and the United States, show that Douglas fir is weaker than longleaf pine by about 10 per cent. so far as the modulus of rupture is concerned; but, on the other hand, is about 10 per cent. stronger on the basis of fibre stress at the elastic limit. Since, properly, the basis of working stress for timber as well as for other structural materials should be the elastic limit, it may very properly be said that Douglas fir has a superior flexural strength for working loads. In longitudinal shear Douglas fir is from 20 to 25 per cent. weaker than longleaf pine, a circumstance that should be carefully taken into account for short, heavily-loaded beams. Where rigidity or stiffness is a desirable factor, Douglas fir may very profitably be used, since it possesses a modulus of elasticity from 4 to 10 per cent. greater than that of longleaf pine. For use as columns, Douglas fir is inferior to longleaf pine, since practically all tests show it to possess a maximum crushing strength from 10 to 20 per cent. less than that of the latter. Consequently, column formulas must be somewhat more severe than for the southern product. On the other hand, the strength of Douglas fir in compression perpendicular to the grain is some 10 per cent. greater than that of longleaf pine, so that where sills or blocking are concerned the native product is at an advantage.

In view of these comparative experimental results, it is seen that each material has certain special and distinctive advantages, but so far as ordinary and average work is concerned, the amount of material required in a large structure involving beams and columns of this material would not be greater if Douglas fir is employed than if longleaf pine were used.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Not so Brisk.

Buying of iron and steel has not been quite so brisk this week, though there has been moderate additions to the business already in hand. The market appears to have sobered down now that stocks which had run very low have been renewed. The market tone is bright however, and the announcement of railway programmes and the probability of a settlement in the near future of the shipyard dispute, all tend to increase the optimism which has been steadily gaining ground for some weeks past. It is apparent that the finishing branches are growing more active, and consumptive demand is increasing, though not at the rate that the activity of the market last week would suggest. There has been a certain amount of speculative buying, but it would appear to be less in the Midland market than has been the case, according to report, in the more Northern centres. Values continue firm, with an upward tendency in some departments, and business in pig iron, galvanised sheets and steel billets has been done this week at better figures. Both buyers and sellers are cheerful, and are looking more hopefully to the future.

Steel Prices.

There continues to be a stiffening up of values in the semi-finished steel market, and all the Midland makers of billets now appear to be quoting something over £8. The market is still active, notwithstanding substantial purchases a week ago, and business is done at date at £8 2s. 6d. to £8 5s. Sheet bars command about £8. Most consumers of raw steel have satisfied their prospective requirements, and the steel works are in a much better position. Belgian efforts to enter the market are almost invariably unsuccessful. It is not now the practice to quote, and offers made by British buyers are generally below Belgian ideas. Some business can, however, be done in joists, where urgent delivery is not called for, and the consumer can take his material direct from the ship. It is also possible to buy favourably for shipment from Antwerp to foreign destinations, and Birmingham merchants are doing a certain amount of this class of business. Finished steel prices are nominally unchanged, but the tendency is undoubtedly firmer. The efforts to obtain price agreements have been abandoned for the present in the small bar trade, but though there is still a certain amount of elasticity about prices, on the whole they are firmer, and some firms are at date asking £10, while practically all others refuse to go below £9 15s. Steel masters in the Midlands find a certain amount of opposition from re-rollers, who prefer to retain their freedom to quote according to circumstances. The promise of new business from the railways has had a wholesome effect, the rail mills being busier, and constructional engineers are getting much more inquiry which promises to materialise. For the time being, any anxiety with regard to the possible dumping of Ruhr steel has disappeared.

Control of Steel Bar Prices.

The efforts made to secure some sort of price agreement in the small steel bar trade have not been successful. Many of the makers are averse to premature advances, and the re-rollers generally are fighting shy of agreements. This is a keenly cut market, in which many of the firms quote prices on the basis of their steel purchases, giving the customer the full benefit of such favourable bargains as they are able to make. It is not thought that the time is ripe for the re-establishment of the Steel Bar Association. The fact also is recognised that there is still a large amount of unemployed plant which is well able to absorb whatever new business is forthcoming. The leading steel concerns are very much more concerned about the securing of heavy tonnages, mass production being, under present conditions, the most essential element to the making of profit.

Steel Scrap.

The market for steel scrap continues to improve. A number of sales have this week taken place at prices substantially above those ruling a month ago. £4 5s. per ton has readily been paid, and higher prices are considered inevitable within the next few weeks. Consumers' stocks are low, and holders of material are not anxious to sell, preferring to await the advent of better prices.

Dearer Pig Iron.

The larger purchases of raw iron have accentuated the diversities existing in the pig iron market, as shown in the experiences of individual smelters. Some of them have not only found outlets for stocks which were causing anxiety, but they have also disposed of a considerable part of their output between now and the end of the quarter. With others the outlook is still perplexing. Business has not expanded sufficiently to bring into operation additional furnaces, and in view of the decision of coke makers to adhere to the 24s. figure at ovens, the owners of idle furnaces are not inclined to relight. The demand for forge material is still small, but foundry qualities are in better request. Many Derbyshire smelters this week wanted £4 15s. for No. 3 foundry iron, but others were prepared to accept £4 12s. 6d., which is the price named by Northamptonshire makers. Forge iron of Northamptonshire make is quoted about £4 3s. 6d., and Derbyshire £4 6s. to £4 7s. 6d., which is an advance of 2s. 6d. on the week. There is nothing in the state of the forge iron market, however, to make the advance generally effective.

Manufactured Iron.

The Staffordshire finished iron trade generally now has a somewhat more hopeful outlook. Warehouses are re stocking and some foreign business, including orders from Russia, formerly a most useful market, has arrived. The marked bar mills continue to be best employed, with prices firm at £14 10s. Medium quality bars have made only trifling progress, and values are unstable. Makers of common bars for use in the nut and bolt industry report that customers are disposed to cover themselves for a little time ahead, which has not been the case for a long time. Orders, therefore, are coming along more freely. Prices have not moved, and much of the business in Staffordshire is done at £10 12s. 6d., though some firms continue to quote £10 15s. Belgian bars have become dearer and are much less formidable as a competitor with Staffordshire nut and bolt bars. Continental bars are now quoted £9 to £9 5s., delivered in this district. The slackness in the tube trade continues, and the calls upon the strip mills are restricted. Wrought iron gas tube strip continues to be quoted £12 10s.

Galvanised Sheets.

Business is well maintained in the galvanised sheet industry, and recent orders, for the most part, have been for next year's delivery. For early supplies substantial premiums over the £19 figure have been paid for galvanised corrugated sheets of 24 gauge. The tendency is for the quotation to be advanced to £19 5s.

Railway Work.

Rolling stock firms in the Midlands are extremely gratified to note that at long last the railway companies are coming forward with their programmes, and they are trusting to participate in the big work programmes which have just been announced. The wagon building firms hereabouts have kept fairly busy throughout the recent slump, but it has been, for the most part, on export and electrification account. They are now awaiting the issuing and placing of contracts, and are optimistic as to the amount of work which will be placed outside the companies' own works, and as to the portion they are likely to obtain.

The Boilermakers' Dispute.

Midland, and particularly Black Country, firms connected with the shipbuilding industry, such as the nut and bolt and chain and anchor trades, are this week discussing the probabilities of a settlement of the boilermakers' dispute, which has so seriously affected them since it commenced in April. It is thought highly probable that the efforts which have been made to settle the dispute will now be successful, and they await the result of the conference between the Shipbuilding Employers' Federation and the Boilermakers' Society on Friday with considerable anxiety. It is known that a large volume of work is ready to be given out as soon as the dispute is at an end, and hopes of a considerable quantity coming into the Black Country are entertained.

Obituary.

I regret to have to announce this week, following upon last week's obituary notice of the late Mr. Caleb W. Roberts, the death of another prominent member of Roberts and Cooper, Limited, the well-known Black Country iron and steel manufacturers, in the person of Mr. David Walter Cooper. Mr. Cooper, who was a director and secretary of the firm and head of the Wollescote Galvanising Company, died in Birmingham on Monday. He was a well-known figure on the Birmingham Iron and Steel Exchange, where his presence will be much missed by a large circle of business friends and acquaintances.

Midland Workless.

Again, this week, there has been a decrease in the number of workless in the Midlands, a reduction of 933 being recorded in the latest returns. The total number of persons unemployed in the area now stands at 164,521, of which the Birmingham area accounts for 41,934, Coventry 5454, Cradley Heath 5102, Smethwick 5326, Stourbridge and Brierley Hill 4040, Walsall 6060, and Wolverhampton 7940.

LANCASHIRE.

(From our own Correspondents.)

Manchester, Thursday.

General Outlook.

The recent improvement in the iron and steel markets here does not seem to develop to any extent. There were a good many observers here who were of opinion that the movement was temporary, and these are now rather more confident that they were right; but at the same time the outlook is not at all clear yet, and we have yet to see what will be the effect of the distribution of orders for home work which is to be made by the Government and the railway companies during the next few months. It seems a little unfortunate that the vexed question of tariffs and protection should be brought forward prominently at this time, and that there should be any question about an immediate election; and unless these disturbing elements are banished, at any rate for the duration of the present Parliament, one cannot see how it is possible for business to improve.

Metals.

The non-ferrous metals, with the exception of lead, do not show much movement at present. Copper remains very low, although one cannot yet find many people here who believe that it is absolutely at the bottom. Buyers of copper point to the very large production and the excess over the present rate of consumption, and argue that it is perfectly safe for them to buy only what they need for immediate use, and to keep their working stocks as low as possible. This policy, of course, tends to make the market dull, but it leaves the opportunity open for a sudden rise, if at any time consumers desire again to re-establish normal stocks at their works. This is just what has recently happened in the foundry iron industry here. The reports from America are persistently depressing. It is said that the domestic consumption there is decreasing; but there has been no attempt on the part of producers to limit the production of copper. If the over-production of copper is to continue there may be still lower prices; but one cannot help thinking that the market must now be fairly safe so far as refined ingot and standard copper are concerned. There has been no change reported in the prices for manufactured copper and brass up to the time of writing. The movements in tin have not been of much importance. There seems to be a belief here that the present prices for tin are safe and that the chances are rather in favour of the market than against it. The demand for tin-plates from the consuming industries has certainly been very good, and this has increased the consumption of tin both here and in America. The engineering demand for tin is poor. The extraordinary rise in lead which occurred last week seems to have been caused by an acute scarcity of prompt metal combined with a kind of panic amongst consumers. The premium on prompt delivery as against three months' metal rose at one time to nearly £4 per ton. There was a sharp set-back afterwards, but the price of lead is still very high, and especially of English lead. Lead sheets were put up to £41 10s. per ton, while zinc sheets were still offering at £38 10s. per ton. Spelter has been rather a quiet market while this scare has been going on in lead. Prices have changed very little during the last week or two. They were a little easier at one time, but lately the market has been a little stronger. Some American metal has been coming in.

Pig Iron.

The demand for foundry iron here seems to have slackened a little; but this is not surprising, because a very considerable business has been done during the last three weeks since the Cleveland makers put up their price by 4s. per ton. The belief that the lowest prices of the year had been seen led to the replenishing of stocks, which everyone admits had been allowed to run down to a figure much under the average. The question now is whether

most ironfounders have enough stocks of iron to last until a much better demand for castings sets in. Makers of Midland pig iron seem to be satisfied with the slight improvement in prices, and those who have their furnaces fully occupied probably do not desire any further rise, for any substantial advance in present prices would bring more of the idle furnaces into operation and the consumption of foundry iron in this district is not good enough to justify any serious increase in the output. A steady trade at present prices—say, about 100s. per ton delivered in Manchester—will suit makers much better than a higher price which would bring competition with it.

Steel.

What is wanted now is such an increased demand for manufactured steel as would enable the steel makers to sell finished steel at a profit. At present profit in the steel trade seems confined mainly to makers of billets and semi-steel. Sections and plates, with perhaps the exception of boiler plates, have for a long time been sold at or below the bare cost of production, and one begins to hope that this unsatisfactory time is at last coming to an end. Some sellers of steel plates here have been asking £10 10s. per ton, and one understands that business has been done at that figure; but in other districts common steel plates are to be bought at much less. Merchants here, when quoting for angles and joists, usually try to obtain £9 10s. per ton, but one would not like to say that business could not still be done at £9 5s. It may, however, be admitted that the tone of business in the steel trade is better than it was, even if in some cases the old prices are being accepted.

Scrap.

With the exception of the non-ferrous scraps, the market for old material is decidedly stronger. There is much more demand for steel scrap and a slightly larger demand for cast and wrought scrap. It would seem that there is now a chance of scarcity of supply in heavy steel melting scrap, and some Sheffield consumers are anxious to buy. In Lancashire the price of this scrap at the moment is 75s. on trucks, or roughly about 5s. less than the value of wrought scrap; but there seems to be a probability of the prices coming nearer together. For heavy wrought scrap 85s. per ton delivered has been paid. In cast scrap there is not very much being done yet, but the prices for good qualities range from 85s. to 90s. per ton.

BARROW-IN-FURNESS, Thursday.

Hematite.

The hematite pig iron trade has made no further movement during the week. Confidence prevails, nevertheless, but the improvement will be slow, and it will be towards the end of the year before there is any evidence of a substantial character that trade is again on the up gradient. The various schemes proposed by the British railway companies which have already been mentioned will certainly affect this district and will increase the demand considerably. The prolonged boilermakers' lock-out is undoubtedly holding up the shipbuilders and engineers very considerably, and if only a settlement could be reached there would be an increase in the amount of business done by local iron producers. It would lead, no doubt, to the placing of more orders for forward delivery, for prices are comparatively low and, if anything, there is a tendency to lift. Continental trade is only moderate, and the American business is not great yet. Scotch buyers have been taking a little more, and more mixed Bessemer numbers are going into the Midlands. The business in special qualities is fair.

Iron Ore.

There is no change in the state of the iron ore trade, nor will there be until there is more life in the iron markets. The mines are not producing anything like a normal amount, and some are practically idle. Business in foreign ore is slack.

Steel.

The prospects in the steel trade are a little better, and hopes are expressed that the railways in this country will become bigger customers. Orders held are not heavy at the moment, but there are better chances of a continuance of activities than there were.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Prospect.

THE heavy steel trade remains in a very quiet state, but a much brighter outlook has been created as a result of the decision by the London, Midland and Scottish Railway Company to place substantial contracts. Sheffield and other towns in the immediate locality are particularly well able to cope with railway orders. Plant has been almost in idleness for a long time, waiting for the inevitable placing of contracts, and when the orders actually arrive Sheffield will be in a position to deal with them immediately. Preparations are already being made, and some of the open-hearth furnaces which have been idle for many months will soon be working once more. Apart from the expected railway orders, a general revival is anticipated early in the New Year, though it is agreed that Sheffield's normal trade position cannot be regained until the European question becomes more settled. The lighter steel trades are expecting to share to a large extent in the railway contracts. There is certain to be a large increase in the demand for tools of the kind in which Sheffield specialises. In other sections greater activity is recorded, and good orders have been received for hammers, saws, picks, and edge and farm tools.

Cutlery and Plate.

The improvement recently recorded in these industries continues, and Christmas trade orders are already coming to hand. This is particularly so in the case of electro-plate. Competition, however, continues to be so keen that the profits being made are very small. In the cutlery section most business is being done in stainless knives. The majority of the orders are for the home market. The export trade is quiet, the chief overseas customers being New Zealand and Australia. As a result of the falling off in the imports of cheap continental products an improvement is now noticeable in the sale of Sheffield scissors and small knives.

Singapore Naval Base.

Newton, Chambers and Co., Limited, Thorncliffe Ironworks, Chapeltown, have secured a contract from the Admiralty for the construction of steel work for the new naval base at Singapore. The work consists in supplying and erecting eleven mild steel oil fuel storage tanks of the largest size. There has been keen competition for this order, but in view of the serious unemployment prevalent in the Chapeltown district Messrs. Newton, Chambers and Co. made special efforts to secure it. Their constructional department will be found almost full occupation for more than six months. The same firm has also been successful in securing an order for a large gas purifying plant for the South of England and for a gasholder for Liverpool.

A Famous Coal Seam Struck.

There is the prospect of big colliery developments in the Doncaster area. Messrs. Barber, Walker and Co., the owners of the Harworth Main Colliery Company, have for more than two years been carrying on sinking operations near the village of Harworth. In the No. 1 shaft they have been successful in striking the Barnsley seam at a depth of 929 yards. The seam is 6ft. in thickness, and Mr. C. W. Phillips, the general manager of the company, states that the coal found is of splendid quality and is equal to any that he has seen at other pits in the area. When the colliery is in full working order employment will be found for between 3000 and 4000 men. About 5000 tons of coal per day will probably be drawn. It is estimated that the Parkgate seam at Harworth is about 250 yards below the Barnsley seam. Most of the surface buildings are completed and the pithead gear of reinforced concrete is constructed. A system of electric winding is to be introduced. A model village is to be erected to house the mining population, and between 200 and 300 houses are at present in course of erection. The Harworth enterprise was at first in the hands of a concern of which Herr Hugo Stinnes was the head. During the war the foreign interests were wound up and Messrs. Barber, Walker and Co. purchased the undertaking through the Board of Trade. It was not until September, 1921, that the company commenced sinking operations in earnest. One of the many difficulties met with was water, the greatest quantities encountered rushing out at the rate of 800 or 900 gallons a minute. This obstacle was overcome by means of cementation.

Winter Relief Schemes.

Sheffield City Council has decided to spend £300,000 on works of municipal value during the coming winter in order to lighten the unemployment problem. This will bring the amount spent on relief work by the city to over £1,000,000. It is estimated that the latest work to be put in hand will find employment for about 2000 men for periods varying from three to eighteen months. Altogether twenty-six schemes have been prepared, and these include work at baths, parks, cemeteries, bridges, and roads. The most costly item, involving an expenditure of £85,000, will be the widening of part of the much-used Worksop Road. Two further units of the new extension of the sewage works are to be constructed at a cost of £42,000, and on the erection of public baths there will be an expenditure of £30,914.

Advice to Young Engineers.

Professor J. Husband, of Sheffield University, has been elected president of the Sheffield and District Section of the Junior Institution of Engineers. In his presidential address on "Recent Progress in Engineering" he made the statement that it would be a desirable thing if young English engineers could be encouraged or assisted to visit foreign countries with a view to broadening their views. Such a system, he said, would pay. Professor Husband presented the local section silver medal to Mr. Arthur Reginald Chaytor, A.M.I.E.E., for his paper on "The Manufacture of Seamless Steel Tubes and Gas Cylinders."

Hull Gets Railway Work.

The London and North-Eastern Railway Company is proposing to make an early start on the construction of a new line for the diversion of passenger traffic from Cannon-street Station to Paragon Station. The former was on the Hull and Barnsley Railway and the change has been brought about by the grouping system. When the new line is constructed Cannon-street Station is to be converted into a goods depôt. This railway company has also decided to do a considerable amount of work in the renewal of permanent way and bridge strengthening. The large sums which it is proposing to spend on wagons should find considerable work for outside firms. Sheffield, Penistone, Rotherham, and Stocksbridge are hoping to get their share of orders for rails and for buffers, springs, and tires.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Revival.

ALL the indications point to a progressive improvement in the iron and steel trades, and a marked revival in business is anticipated when the winter schemes of bridge building, railway development, and ship construction are in operation. The export trade, too, is showing signs of reviving, and evidence of this fact is afforded in the returns for October for the Cleveland district. For the first time since April the total exceeds 100,000 tons, and the improvement extends to both branches of the trade—pig iron and manufactured iron and steel. The pig iron shipments advanced from 34,827 tons in September to 41,935 tons last month, and whilst the deliveries to Scotland show a marked increase, it is noteworthy that Belgium, Denmark, and Holland all received record deliveries for any month in the current year. The despatch of 4487 tons of pig iron to France also marks a big improvement, and 4820 tons were sent to Germany, despite the chaos in that country. For the first time this year there were no exports across the Atlantic, but that is a trade which in the nature of things is bound to be intermittent, and manufacturers are more concerned with the cultivation of trading relations with the Continent, where there is evidence of a growing demand for British pig iron. India was again the largest buyer for manufactured iron and steel, with a total delivery of 17,530 tons; whilst trade with New Zealand and Australia amounted to 6684 tons. Germany took 6532 tons of steel, Egypt 5608 tons, Japan 1935 tons, and Nigeria 2158 tons.

Cleveland Iron Trade.

The Cleveland pig iron market maintains all its strong features. Buyers are showing greater freedom in placing orders, being evidently convinced that nothing is to be gained by waiting, and some, at least, are placing orders to cover future requirements. There is now a very confident feeling that the boilermakers' dispute will be settled, and as orders are already being placed in connection with the Government's and the railway companies' schemes for the relief of unemployment, everything points to a very big consumption of pig iron in the near future. Forward buying under these circumstances offers certain attractions, for the output of pig iron is very limited, and consumers in some cases are disposed to make sure of supplies. Moreover, prices are not likely to fall. The bulk of the business done this week has been on home account, quite a good number of contracts having been placed; but the volume of the foreign trade is very small in comparison with the number of inquiries circulating. Makers are being asked for quotations for the first quarter of next year, but this business has not got beyond the inquiry stage, and generally the price seems to be rather an obstacle. Still, continental costs are rising, and it is fully expected that many of these inquiries will ultimately mature. Germany, in particular, is wanting iron, but the obstacles to business in that direction are manifestly enormous. Prices generally are firm but unchanged, No. 1 being 107s. 6d., No. 3 G.M.B. 100s., No. 4 foundry 99s., and No. 4 forge 98s. per ton.

Hematite Pig Iron.

Some large sales of hematite pig iron are reported to have been made this week to Sheffield and South Wales consumers, and also to the Continent, and makers, who now have well-filled order books, are endeavouring to raise the price a little; but orders for mixed numbers can still be placed at 100s., or for No. 1 at 101s. per ton.

Ironmaking Materials.

The foreign ore trade is lifeless. Consumers are well stocked and are not inclined to pay the present price of 23s. per ton c.i.f. for best Rubio. Some of the coke makers are still quoting 30s. for good medium furnace qualities, but it is understood that contracts have been placed at 36s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade is in a healthier condition than for some time past, the great schemes for railway reconstruction and development having given a decided impetus to the demand. Operations at the works are growing more active, and the winter outlook is now considered bright. Makers have here and there advanced prices to the extent of 5s. to 7s. 6d. per ton.

The Coal Trade.

The Northern coal trade remains very satisfactory. The colliery position is well assured for the rest of this year, and as a rule producers are advancing their ideas. There appears to be expectation that more orders for large quantities of steam coals for the German State Railways may be placed. Despite the reports of orders having gone to Scotland, the Midlands, and Wales, there are those who anticipate the placing of more business on the Northern market for next year. The question of sterling credits, however, is still the ruling factor in all this kind of business. The demand from continental sources is not very extensive just now, though there are numerous inquiries, and merchants are taking out their full quantities previously booked for shipment abroad, so that the outlook is improving. The steam coal section is still the strongest in the market, with producers of best qualities asking a minimum of 26s. per ton f.o.b. prompt. All other classes of steams are demanding enhanced figures, while secondary sorts are also on the upward move. Small steams are steady, but rather variable and contingent upon the position of the individual collieries. Durham makes are very steady as a rule, and in most cases the collieries are in a fairly comfortable position for tonnage. Gas coal is steady, while coking is firm and bunkers are equally improved. The coke market is irregular and erratic. Patent oven coke is weak in tone and lower prices are indicated. Gas coke is scarce and obtainable only at top figures.

Iron and Steel Imports.

Statistics presented at this week's meeting of the Tees Conservancy Commissioners showed that the imports of crude sheet bars, blooms, billets, slabs, &c., during October totalled 11,086 tons; pig iron, 1014 tons; and plates, bars, angles, 447 tons. For the past twelve months imports totalled, in the classes mentioned, 77,612 tons, 14,748 tons, and 11,289 tons respectively, comparing with 54,611 tons, 34,631 tons, and 7125 tons in the previous twelve months.

SCOTLAND.

(From our own Correspondent.)

Firmer Tendency.

The slight improvement noticeable in the steel and iron trades last week has been maintained and the various markets are inclined to firm up a little. Conditions are said to be brighter than for some time back, and the outlook will be still better if prices can be kept at reasonable levels. Competition from abroad has not been quite so keen of late, but producers would be ill advised to ask enhanced prices on that account.

Shipbuilding—Continued Low Output.

With conditions at the shipyards still unchanged the output for October was exceedingly small, though double that of the preceding month. The total consisted of six vessels of 12,019 tons aggregate, three of which practically comprise the total:—The Hopeland, cargo steamer, 4500 tons, built by Barclay, Curle and Co., Limited, for the Hopemount Shipping Company (Stamp, Mann and Co., Limited), Newcastle-on-Tyne; Gujarat, s.s. motor, 4320 tons, by Harland and Wolff, for Andrew Weir and Co., London; and the Baron Glenconner, cargo steamer, 3000 tons, by Napier and Miller, for the Kelvin Shipping Company, Limited (H. Hogarth and Sons), Glasgow. Several orders for small steamers of various descriptions have been placed during the month and others are under consideration, and these, along with the work hung up meantime, will provide a fair amount of work when the boilermakers' dispute is at an end. Even with an early re-start now, it is almost impossible that the winter months could be anything but one of the worst periods in the history of the industry. The output for this year to date is less than half that of last year for a similar period, and is far and away the lowest since the end of the war.

Better Demand for Pig Iron.

Increased activity is reported in the pig iron market. Foundry qualities are in larger request for both home and export delivery and are quoted at a firmer figure. This tendency to higher prices does not find much favour, but to the present at least the increased turnover has not been arrested. No. 1 foundry has again been quoted at £5 5s. per ton, with hematite on the same level and No. 3 foundry 5s. per ton less. There should be no scarcity of supplies, because even with outputs diminished stocks have been accumulating for some time.

Steel.

Though there is a firmer tone in the steel market, there is not much activity in certain departments. In fact, the course of business shows little alteration. Plates are still very short of specifications, and if sections show up better they are still far from being busy. The sheet mills have enough orders on hand for light gauges to keep the works going for some time, but specifications for heavier sheets are extremely slow to materialise. Taken all over, the orders for export steel which are placed with local producers are mostly for light material.

Bar Iron Busier.

The bar iron trade has participated in the slight improvement in industrial circles. Bars for export and home delivery are in better request than for some time, and here also makers are hinting at increased prices. At present, however, the nominal quotation of £12 per ton for Crown bars for home delivery still stands, while export can be done about £11 to £11 5s. per ton f.o.b. Glasgow. Re-rolled steel bars, also, are in greater demand.

Coal—Smaller Demand.

Several circumstances have combined to restrict the turnover in the Scotch coal trade. In all districts the collieries are fully booked up for round fuel for export and have really nothing of any consequence available for about ten days or a fortnight. Owners are inclined to ask higher prices for future delivery, and buyers are holding off in consequence, only being prepared to pay current rates for immediate accommodation. New business in round coal, therefore, is rather quiet just at present. Washed nuts are moving off regularly at current rates. The supply of small steamers has been restricted, but nevertheless the docks at Methil and Leith have been very busy. The home market is slow apart from the demand for the best qualities of house coal.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

The conditions prevailing in the steam coal trade are far from being satisfactory, and the outlook gives no promise of an immediate improvement. It was thought at one time that when the tonnage delayed by the recent gales arrived up, there would be considerable congestion at the loading ports; but so far steamers have not come to hand in large numbers, and the consequence is that, with the exception of Swansea, there have been quite a number of idle loading berths during the past week. In the case of Swansea, there has been a list of steamers waiting to get into berth, and the reason for this difference, as compared with the other ports in this district, is the fact that anthracite coals are more difficult to obtain, as the outputs at the various collieries are not particularly extensive and there are consequent delays in loading. The shortage of tonnage at the ports where steam coals are mainly shipped has, naturally, caused weakness for prompt shipment in the market for these qualities, and, unfortunately, many collieries have suffered and have been temporarily idle. Salesmen have been prepared to cut their prices in cases in which they can secure immediate shipment in order to get them out of their difficulties; but comparatively few exporters are in a position to take advantage of the concessions, and if they take prompt tonnage it means that in order to obtain the tonnage required they have often to pay a rather higher rate of freight, so that there is not much to be gained in the long run. Apart from this, there is not a great deal of fresh business about, and continental consumers and buyers are not coming forward with many inquiries. The hold-off attitude is still being pursued to a large extent, so that, altogether, the tone is on the quiet side. At one time last week, it looked as if, before very long, a different complexion might overcome the market in view of the expectation of a substantial demand for coals for Germany, and the report that two well-known firms had made arrangements regarding the opening of credits in London. It is not doubted that the two firms in question have been negotiating and that they have secured large orders; but, unfortunately, the report is now current that these orders are not for coals for shipment from this district, but for North Country coals. This is very disappointing, as it was expected that this business would have given a much-needed fillip to the coal trade. As regards operations over next year, more business has been arranged, but it is not particularly extensive, and there has been no material improvement in the prices that have been obtained. The Central Argentine Railways have purchased about 150,000 tons of large coals for delivery over 1924, and superior dry coals have been done over the same period at 27s. One of the French State Railways has bought about 20,000 tons of large steam qualities for shipment over this month and next.

Miners and their Wages.

The South Wales coalowners, realising the disappointment that prevails as the result in the fall in the wage-rate for this month and next, decided, at the latter end of last week, to continue paying for a further two months a higher subsistence wage than that awarded by Lord Buxton to the lower-paid married workmen. It is questionable, however, whether this will have any effect upon the workmen as regards their attitude towards a revision of the present agreement, and according to one of the men's leaders the action of the coalowners in giving the higher subsistence wage to the lower-paid workmen, has caused the higher grades of workmen to be dissatisfied. They contend that they have been ignored by the coalowners, with the result that serious anomalies have been created which threaten to bring about a division among the miners. It is stated that under the new conditions, a haulier will only receive 4d. per day more than a labourer, and ostlers, who have to go twice a day to work and who work continuously on Sundays, will receive 1s. a day less than the labourers. Stokers will also get less than labourers, and altogether it looks as if there is likely to be a certain amount of friction, and the men in the Rhondda are demanding that meetings shall be held to consider the position.

Tin-plate Workers' Notices.

In accordance with the decision come to at meetings held recently, which were of quite an unofficial character, the enginemen and firemen engaged in the South Wales tin-plate industry presented their notices on Monday last to terminate in twenty-eight days' time. Their action is quite unconstitutional, and against the advice of their leaders. Hope, of course, has not been abandoned that something will be done in the meantime to avert such a disaster as a stoppage in the industry, which will, if it takes place, affect works reaching from Llanelly to Lydney.

Current Business.

The prompt demand for coals is on a comparatively small scale, and with few exceptions collieries are barely able to maintain recent quotations for the reason that they are short of tonnage to keep them going. Some of the best Admiralty large coals are relatively steadier than other grades, and are quoted at 28s. for supplies ahead. Monmouthshire coals and drys are weak, while prices are getting down to, if they are not absolutely at, cost prices. Superior qualities of smalls maintain a fairly good tone, but the inferior descriptions are on the weak side and are plentiful. The inquiry for patent fuel is quiet, the comparatively high costs of production making it difficult for makers to compete with superior large coals. Coke remains practically unchanged. Anthracite coals are easier, with the possible exception of best grade machine-made nuts and cobbles.

Latest News from the Provinces.

NORTH OF ENGLAND.

New Industries for Tees-side.

Further great industrial developments are foreshadowed on Tees-side as the result of the acquisition of a large tract of land at Cargo Fleet by the Rio Tinto Company, Limited, a firm of world-wide reputation for the manufacture of copper and other mineral commodities. The land, which has a large frontage on the river Tees, was acquired originally from the Tees Conservancy Commission by the Cargo Fleet Iron Company, Limited, from which it has been purchased by the Rio Tinto Company. It is understood that it is the intention of the firm to establish two branches of industry on the site. One concerns the manufacture of copper, and the other covers a number of by-products. A great part of the raw material will be brought to the Tees from the firm's mines in the province of Huelva, Spain, and for its reception the Rio Tinto Company intends to build new wharves of its own at Cargo Fleet.

Admiralty Order for Oil Tanks.

The Admiralty has placed a further order with the Tees-side Bridge and Engineering Works, Middlesbrough, for twelve oil tanks to be erected abroad, each 116ft. in diameter by 45ft. 6in. high, and having a capacity of 3 million gallons of oil per tank. The contract provides for the supply, delivery, erection and testing complete of these tanks on foundations supplied by the Admiralty, and the order has to be completed by May, 1925. The present order will complete a series of thirty-three similar tanks which have been placed with the Tees-side Bridge and Engineering Works, Limited. The whole of the steel plates and sections required in the tanks will be manufactured in the Tees-side district.

WALES AND ADJOINING COUNTIES.

Tin-plate Prices.

The Stabilisation Committee for the steel and tin-plate industry has decided to continue the principle of stabilisation of prices for a further period of twelve months, which does not, of course, mean the elimination of the variation of prices. The tin-plate market is firm.

Steel Workers' Wages.

The South Wales Siemens Steel Association has decided to continue the existing bonus to workmen plus the 7½ per cent. advance operating under the last ascertainment. This will come into operation early in February, and will mean an advance of about 1s. 6d. in the £ to each worker.

Australian Engineering Notes.

The Electrical Federation of Victoria has decided to hold an electrical exhibition in Melbourne in September, 1924, which will remain open for at least four weeks. The exhibition will be designed to cover every phase of electricity and its uses. Wireless in all its ramifications will be a feature both in telegraphy and telephony.

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The Queensland Government has accepted the tender of Walkers, Limited, Brisbane, for the erection of a sugar mill at Tully River. The price is £389,480. The new mills will have a crushing capacity of 150,000 tons of cane in a season. The Sydney (N.S.W.) Electricity Department is calling for tenders, returnable on December 3rd, for the supply and delivery of six 33,000-volt incoming feeder panels, six 33,000-volt transformer control panels, six 5000-volt transformer control panels, and fifteen 5000-volt feeder panels, all complete with oil switches, instrument transformers, instruments, relays, bus-bar supports, leading-in insulators, choke coils, lightning arresters, &c. The Department also calls for the following tenders, also returnable on December 3rd:—Supply and delivery of 15,800 yards of .4 three-core paper-insulated lead-covered and armoured high-tension 11,000-volt cable, 10,532 yards of 7/036 section three-core pilot cable for a pressure of 600 volts; and 5266 yards of combined telephone wires and cable with three-core 7/036 section, and three pairs No. 19 telephone wires. The following tender, called for by the same Department, closes on January 21st, 1924:—Supply and delivery of sixteen split conductor panels to replace existing panels supplied by various makers, the panels to be complete with oil switches, disconnecting switches, instrument transformers, instruments and relays, and bus-bar supports; working pressure, 5250 volts.

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Following an inter-State conference of tramway engineers in Melbourne, a suitable design for a standard rail for the Commonwealth was agreed upon. The object of the conference was to arrange for a rail which could be rolled in Australia. At present such rails are imported from Great Britain and America. It is suggested that the different tramway authorities should pool their requirements, so that the rails could be rolled in paying quantities either at Newcastle or Lithgow.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

H. E. Weatherley and Co., Limited, inform us that they have taken new and commodious premises as works and showrooms, and ultimately as offices, at 5 and 6, Chicheley-street, York-road, Lambeth, S.E. 1.

Sir W. G. Armstrong, Whitworth and Co., Limited, and Vickers Limited, The Arsenal, Constantinople, request that, in view of the British Post Office at Constantinople having been closed, all communications intended for them shall be in future addressed to Messrs. Armstrong-Vickers, Box 202, Galata Post Office, Constantinople.

Owing to the large number of foreign high-speed drills which are being imported into this country, low in price and often of very inferior steel, the makers of "Novo" high-speed twist drills have made an arrangement with the makers of the high-speed steel so to reduce the price of genuine "Novo" drills that they can meet this foreign competition. The steel used will be the same as hitherto and will contain a minimum of 14 per cent. tungsten. Charles Churchill and Co., Limited, of 9-15, Leonard-street, Finsbury, E.C. 2, will, as hitherto distribute these drills.

We are informed by Vickers Limited that a consolidation of its hydro-electric department for the purpose of attaining more compact organisation and greater promptness in correspondence is taking place. The headquarters of the department is being established at Barrow, and the firm requests that correspondence, &c., having reference to water power equipment and hydro-electric projects of all kinds should in future be addressed to Vickers Limited, Hydro-electric Department, Barrow-in-Furness, England. Mr. W. H. Munro has been appointed chief of the department.

Test Codes.—We have received from The American Society of Mechanical Engineers, 29, West Thirty-ninth Street, New York, copies of two codes just issued—The Test Code for Hydraulic Power Plants and their Equipment and Rules for the Construction of Low-Pressure Heating Boilers. The Test Code for Hydraulic Power Plants is the first of a series of sixteen test codes to be issued during the coming year by the Power Test Code Committee, as a result of its years of work on the revision of the test codes of 1915. The revised Heating Boiler Section constitutes Section IV. of the 1923 edition of the Boiler Code. The Steel Plate Section of this code embraces an important innovation in the form of special rules for the construction of low-pressure boilers with welded joints. The price of these codes is 80 cents a copy (to members 70 cents) and in quantities of 25 or more 65 cents.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	19/6 to 26/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 5 0	—
No. 1 Foundry	5 5 0	—
No. 3 Foundry	5 0 0	—
N.E. Coast—		
Hematite Mixed Nos.	5 0 0	5 0 0
No. 1	5 1 6	5 1 6
Cleveland—		
No. 1	5 7 6	5 7 6
Silicious Iron	5 7 6	5 7 6
No. 3 G.M.B.	5 0 0	5 0 0
No. 4 Foundry	4 19 0	4 19 0
No. 4 Forge	4 18 0	4 18 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge*	—	—
„ „ Foundry	4 12 6 to 5 0 0	
(3) Northampton—		
Foundry No. 3	4 12 6	—
„ Forge	4 2 6	—
(3) Derbyshire—		
No. 3 Foundry	4 12 6 to 4 15 0	
Forge	4 6 0 to 4 7 6	
(3) Lincolnshire—		
No. 3 Foundry	4 13 0	—
No. 4 Forge	4 10 0	—
Basic	4 11 0	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	5 12 0 (*a*) / 5 17 0 (*b*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 0 0	—
Best „	13 0 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 12 6 to 10 15 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ½in. and up	10 0 0	—
Sections	9 15 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	9 5 0	—
Boiler Plates	13 0 0	—
Joists	9 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	12 10 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 15 0†	—
Light „	9 5 0 to 9 15 0†	
Billets	8 10 0 to 11 10 0†	
Manchester—		
Bars (Round)	10 5 0 to 10 10 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 5 0 to 10 10 0	
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 0 0 to 8 5 0	
Hoops	12 10 0	—
Soft Wire Rods	11 10 0	—
Midlands—		
Small Rolled Bars	9 15 0	—
Billets and Sheet-bars	8 0 0 to 8 5 0	
Gas Tube Strip	10 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	19 0 0 to 19 5 0	
Angles	9 10 0	—
Joists	9 10 0	—
Tees	10 10 0	—
Bridge and Tank Plates	10 0 0 to 10 5 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/1½ to 23/4½
Block Tin (cash)	213 0 0
„ (three months)	213 0 0
Copper (cash)	61 2 6
„ (three months)	61 12 6
Spanish Lead (cash)	29 15 0
„ (three months)	27 10 0
Spelter (cash)	33 0 0
„ (three months)	32 17 6
Manchester—	
Copper, Best Selected Ingots	64 10 0
„ Electrolytic	65 0 0
„ Strong Sheets	92 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
„ Condenser	0 1 2
Lead, English	32 10 0
„ Foreign	30 0 0

FERRO ALLOYS.

(All prices now nominal.

Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/5 per lb.	
	Per Ton.	Per Unit
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£22 0 0	8/-
„ 8 p.c. to 10 p.c. „	£21 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£50 0 0	18/-
„ „ 1 p.c. „	£60 0 0	21/-
„ „ 0.75 p.c. carbon	£65 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£16 for home, £20 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
„ „ 75 p.c.	£18 0 0 scale 6/- per unit	
„ Vanadium	19/- per lb.	
„ Molybdenum	9/- per lb.	
„ Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£130	
Cobalt	11/6 per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

	Export
Scotland.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	23/6
„ „ Nut	24/-
„ „ Splint	24/6 to 26/-
„ „ Trebles	22/9
„ „ Doubles	22/3
„ „ Singles	19/-
Ayrshire—	
(f.o.b. Ports)—Steam	23/6
„ „ Splint	24/6
„ „ Trebles	22/9
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	23/- to 24/3
Screened Navigation	27/6
Trebles	26/3
Doubles	23/3
Singles	19/-
Lothians—	
(f.o.b. Leith)—Best Steam	24/-
Secondary Steam	22/9
Trebles	24/9
Doubles	23/3
Singles	20/-
England.	
(8) N.W. Coast—	
Steams	29/-
Household	46/6 to 57/6
Coke	43/6
Northumberland—	
Best Steams	25/- to 26/6
Second Steams	22/6 to 23/-
Steam Smalls	15/- to 16/6
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	24/-
Second	22/6 to 23/6
Household	25/- to 28/-
Foundry Coke	50/- to 52/6

Sheffield	Inland.	
Best Hand-picked Branch	31/6 to 32/6	—
Barnsley Best Silkstone	27/6 to 29/-	—
Derbyshire Best Brights	27/- to 29/-	—
„ „ House	23/ to 24/-	—
„ „ Large Nuts	21/- to 22/6	—
„ „ Small „	15/- to 16/-	—
Yorkshire Hards	21/- to 23/-	—
Derbyshire „	20/- to 22/-	—
Rough Slacks	11/6 to 13/6	—
Nutty „	10/- to 12/-	—
Smalls	7/- to 9/-	—
Blast-furnace Coke (Inland)		30/- to 31/-
„ „ (Export)	f.o.b.	35/- to 36/-

Cardiff—	(9) South Wales.
Steam Coals :	
Best Smokeless Large	27/6 to 28/-
Second „	26/- to 27/-
Best Dry Large	27/- to 28/-
Ordinary Dry Large	26/- to 27/-
Best Black Vein Large	26/6 to 27/-
Western Valley „	25/- to 26/-
Best Eastern Valley Large	24/- to 25/-
Ordinary „ „	23/- to 24/-
Best Steam Smalls	17/6 to 18/6
Ordinary „	16/- to 17/-
Washed Nuts	27/6 to 30/-
No. 3 Rhondda Large	28/- to 29/-
„ „ Smalls	24/- to 25/-
No. 2 „ Large	23/- to 24/-
„ „ Through	18/6 to 19/6
„ „ Smalls	16/- to 17/-
Coke (export)	42/6 to 50/-
Patent Fuel	29/- to 32/-
Pitwood (ex ship)	27/6 to 28/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	40/- to 45/-
Seconds	35/- to 37/6
Red Vein	32/- to 33/-
Machine-made Cobbles	55/- to 60/-
Nuts	55/- to 60/-
Beans	45/- to 46/-
Peas	26/6 to 27/6
Breaker Duff	12/9 to 13/-
Rubbly Culm	14/- to 14/6
Steam Coals :	
Large	24/- to 25/-
Seconds	22/- to 23/-
Smalls	14/- to 16/-
Cargo Through	19/- to 21/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Quotations extremely high and nominal. † Latest quotations available. (*a*) Delivered Sheffield or Glasgow. (*b*) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Position.

In the iron, steel and engineering firms have had little reason to complain of the situation generally, so far as concerned their business activity, there is certainly a feeling now that the outlook is less reassuring. So long as there was a prospect of the end of the passive resistance in the Ruhr being followed by large and regular consignments of coal and coke, and of payment on account of reparations, which would allow the vast programme of public works to be put into partial execution, the engineering industries were buoyed up by a hope which enabled them to tide over the troublous period of the past few months. Despite the assertion that arrangements are being made to furnish blast-furnace proprietors with adequate supplies of coke, the consignments are still so limited that a considerable deficit has to be made up for by purchases abroad at very high cost. While some blast-furnace proprietors are supplied with Ruhr coke at a fairly low price and others are producing their own fuel, many blast-furnaces are employing coke from England and elsewhere, with the result that there is an extraordinary difference in the cost of producing pig iron, and now that there is a falling off in the demand for iron and steel, the discrepancy in prices is giving rise to serious competition. The trade is in a state of unstable equilibrium. As soon as the problem of reparation is in a fair way of settlement, there will be a recovery of activity, for there is an abundance of work to be done in this country, and the State is only waiting for money payments from Germany to enable it to press forward the various electrification, inland waterway and other national schemes. Meanwhile, several of the engineering concerns have contracts in hand for bridgework, railway and other material for countries in which development work is being carried out with French capital, but having regard to the enormous increase in home productive resources, it is evident that more and more attention must be given to foreign requirements, and in view of the absolute necessity of fostering an export trade, the change which is taking place in the world's markets is causing a good deal of uneasiness.

Rolling Stock.

Complaints are becoming more and more rife throughout the country of the inadequate supplies of wagons and trucks. At this time of the year, the demand for wagons reaches its maximum from the beet districts in the north, the wine-growing regions in the centre and south, and the cider country in the west, and it was supposed that the large amount of rolling stock surrendered by Germany, as well as the considerable quantity purchased from England and America, would have been amply sufficient for the purpose, and would have more than provided for the extraordinary development of traffic which has taken place during the past four years. A large amount of this stock has remained unutilised through the necessity of transforming locomotives to burn French fuel and repairing wagons in a more or less dilapidated state, and for a long while past the locomotive and wagon builders have been doing nothing else but effect these repairs, which are not profitable to builders themselves, and, in view of the future service, cost relatively more than new wagons. The situation of the locomotive builders is so bad that they are unable to keep on their skilled hands, who are going into other branches of industry, and if it were not for the orders that are being given out for the transformation of American locomotives, some of the firms would be obliged to shut down their locomotive departments altogether. The Government is being exhorted to recommend the distribution of new orders for rolling stock, but it can hardly encroach upon the prerogatives of the Superior Railway Council, which is pursuing a policy of rigid economy, with a view of making the different lines self-supporting. Meanwhile, it is reported that the Est company proposes to give out orders for 2000 wagons, while the Nord is stated to have in view a partial renewal of its stock at a cost of 175 million francs.

The Motor Trade.

Judging from the reports being circulated by motor car firms, the recent Show brought in so many orders that in some cases the turnover this year is likely to be doubled. This may be attributed to the facilities offered for doing business with countries in which the exchange rate is high, and also to the extraordinary popularity of light cars with low fuel consumption. In view of the high price of petrol, makers have been giving special attention to low running costs, and the results obtained are so far satisfactory that the popular type of car is now firmly established. If the show of touring cars was particularly successful, the exhibition of commercial vehicles that followed it fell distinctly flat. There continues to be a normal business in motor wagons, and the use of these vehicles is steadily increasing, but the commercial branch of the industry cannot be said to be flourishing. Nevertheless, the War Ministry has given out large orders for lorries in the Lyons district, which will keep some of the makers employed for a long while to come.

Suction Gas Wagons.

The trials of wagons with suction gas plants, which have been carried out by the Comité des Recherches Scientifiques and the Automobile Club, terminated last week so far as the road tests were concerned, and the engines and gas plants of the nine vehicles which successfully completed the daily runs, making a total of 870 miles, have been taken down for bench tests, which are to count in the final classification. The running tests appear to have been satisfactory. The average consumption of a 3½-ton wagon is declared to have been 154 lb. of charcoal for 62 miles and of a 5-ton wagon 176 lb. of charcoal. These tests are competitive with the trials of electric wagons, and when all the data are collected, the Comité des Recherches Scientifiques will publish full details whereby it will be possible to form an idea of the future of these two methods of power application. The electric vehicle has a very strong following in view of the possibility of distributing cheap electrical energy all over the country under the national electrification scheme.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

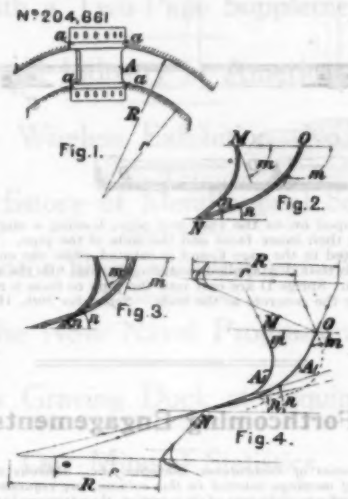
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

204,661. April 29th, 1922.—Steam Turbine Blading, *The Wallsend Slipway and Engineering Company, Limited, Wallsend-on-Tyne.*

This invention relates to steam turbines of the rotor and multiple distributor type, in which the distributors for the successive rotors are formed by fixing blades in the diaphragm walls. The invention provides a form of distributor blades having different profiles at sections of different radii to take into account the difference in the peripheral velocities of the rotor blades at these radii. Fig. 1 shows a distributor blade, seen from the front, fitted to its corresponding diaphragm. Figs. 2 and 3 are sections of the distributor blade showing the difference in profile. Fig. 4 is a velocity diagram. The distributor blade A, at the points where the junction is made with the diaphragm limiting the size of steam orifice at radii R and r, has enlargements or protuberances *a* connected with the formed

N°204,661



surfaces of the blade in such a manner as to eliminate sharp corners of the orifice through which the steam passes. Should the difference between the radii R and r be very pronounced, with a minimum value of $^1/_{12}$th of 2 R, as will obtain in low pressure turbines, it is important to give to the distributor blades a different profile in relation to the section at R from that at r, in order to take into account the appreciable difference in the peripheral velocities of the blades of the moving rotor at these different radii R and r. The inlet angle *m* for the inflowing steam, shown in Figs. 2 and 3, diminishes from the profile O N as at the section at the radius R to the profile M N as at the section at the radius r. The reverse rule applies to the outlet angle *n*, which increases from the section at the radius R to the section at the radius r. Fig. 4 is a velocity diagram showing the effect of a large difference between R and r, with the distributor blade A^1 shaded to take into account the effect of the difference in the peripheral velocities.—*October 1st*, 1923.

GAS PRODUCERS.

204,579. November 14th, 1922.—Oil Shale Retorts, F. Lamplough, Highfield, Feltham, Middlesex, and N. C. T. Harper, 571, Essenwood-road, Durban, Natal.

This still is intended for the destructive distillation of such materials as shale, and is heated by a mixture of the products of combustion, from an outside furnace, and superheated steam. This mixture is introduced at A, rises up through the outer

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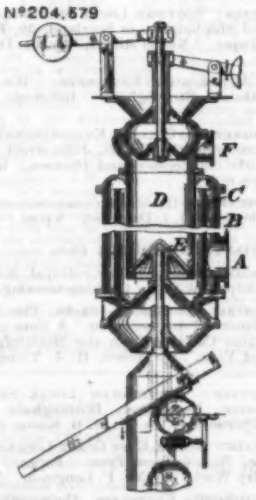

jacket B, down through C, goes into the distillation chamber D through the perforations in the valve bottom E, and escapes, together with the products of distillation, by the outlet F. The valves at the top and bottom of the still are so arranged that the material being treated can be fed in and the waste discharged, without loss of the products.—*October 4th*, 1923.

DYNAMOS AND MOTORS.

204,389.—June 27th, 1922.—Improved Means for Indicating Angular Position particularly Applicable to Wireless Direction-finding Apparatus, John Ambrose Slee, Commander, of 7, Elvaston-place, London, S.W. 7.

The primary object of this invention is to provide means whereby the direction of a distant transmitting station may be read upon a compass card. The projector is connected to the handle of the radiogoniometer of a wireless direction finder, so that as the handle is turned the projector is turned through the same angle. In the drawing A is a bracket which supports a hand wheel B, which may be connected to the search coil of the radiogoniometer of a wireless direction finder. C is a projector carried by a spindle D, also supported in the bracket A. The projector contains a straight filament lamp E with the filament intersecting the axis of spindle D at right angles. The casing of the lamp has formed in its underside a deep narrow

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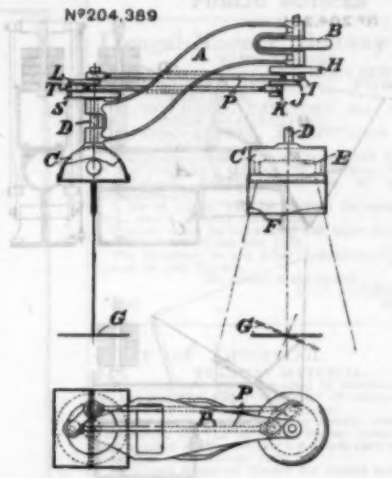

slot F, so that a thin, but wide, beam of light issues from the slot. G is a compass card, the centre of which lies in the axis of the spindle D. Thus the projector C will cause a line of light to appear along a diameter of the card not only when the plane of the card is normal to the axis of the spindle D, but even if it be tilted with respect thereto as shown in broken lines. Attached to the hand wheel B is a disc H, which has projecting downwards from it a pin I fast with a bar J, which carries a second pin K. On the spindle D is a disc S having projecting from it a pin T fast with a bar L, which also carries a pin. P P are two rods which connect the pin K to the pin T, and the pin I to the other pin. The two rods and the two bars J L form a parallel motion, and it will be seen that for any angular movement of the hand wheel B there will be an equal angular movement of the line of light on the card G.—*September 27th*, 1923.

204,499. September 5th, 1922.—A Device for Showing the Temperature Conditions of Electric Machines, Edmund Schröeder, of Maybach-Ufer, 48-51, Berlin, S.O. 36, Germany.

The object of this invention is to provide a cheap, simple and robust temperature indicating device for the current conductors of electric machines, the operation of which depends on the well-known phenomenon that many colours, particularly those derived from certain metallic compounds change their shades of colour with varying temperatures. The indicator is included in the circuit and adapted to alter its colour with changes in temperature, the characteristic feature being that the indicator is surrounded by a heat insulator for the purpose of synchronising the rate of heat flow from the indicator with that from the current conductors. The two pins A A of the plug contact are connected by a plate B made of such cross sectional area and resistance that it will reach the temperature required to produce an alteration of colour in the material with which it is coated only when the parts of the current circuit to be

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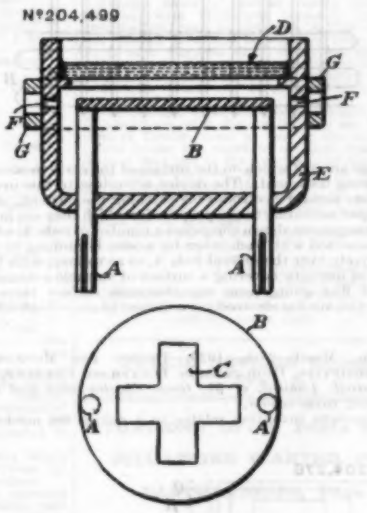


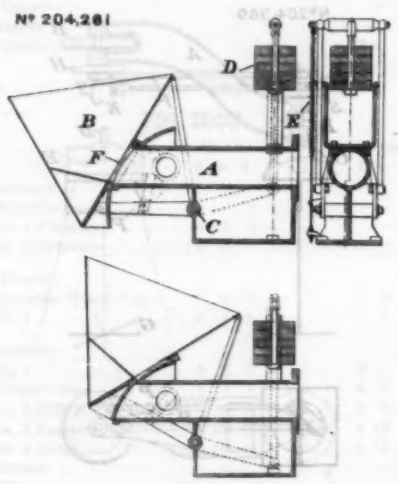
protected have attained the admissible limit of temperature. The plate may show a cross C, or some other design on a ground of a colour the same as that of cold iodide of mercury (H_gI_2), namely, red, but unalterable by temperature change. The cross, which is at first invisible, becomes visible as a yellow figure on the red ground when the limit of temperature is reached. The alarm or indicator plate B is contained in a casing E closed at the top by a glass plate D. Slidable on the casing over holes F is an annular member G, which has corresponding holes capable of being brought to register with the holes F, whereby the quantity of heat allowed to be conducted through the casing from the plate B can be regulated so as to render it possible to arrange that the plate B heats and cools synchronously with the heating and cooling of the winding, or the part of the machine to be protected. The plate will then serve to show the temperature condition of the winding. It is also possible to construct the device to indicate several temperatures. For example, the ground of the plate B might be of a colour that does

not alter until a higher temperature is reached than that at which the central figure or design becomes visible. Thus, a second temperature is indicated by the alteration of the ground on which the figure or design appears.—*October 4th*, 1923.

CRANES AND CONVEYORS.

204,261. January 25th, 1923.—Pneumatic Suction Conveyors, H. J. H. King, Newmarket-court, Nailsworth, Glos.

The inventor states that in pneumatic suction conveying plants as heretofore constructed it has not been found practicable to use more than one nozzle on each system, because free air passes into those nozzles which are not in use and destroys the efficiency of those which are still at work. The object of this invention is thus to provide

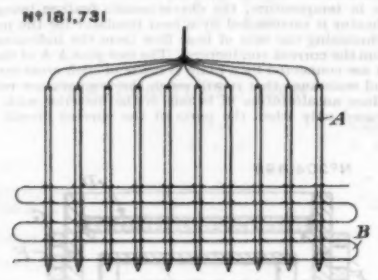


means whereby two or more nozzles may be used on the same system without those out of use impairing the efficiency of the others. The nozzle A is fed through a hopper B, which is mounted on a pivot C and counterbalanced by the weights D and spring E. When in operation the weight of the material in the hopper is sufficient to keep the opening F in its side in register with the nozzle A, but if the supply of material fails the spring raises the hopper, as shown in the lower view, and closes the opening of the nozzle.—*September 27th*, 1923.

MISCELLANEOUS.

181,731. June 17th, 1922.—Improvements in Devices for Detecting and Locating Masses of Dissimilar Electric Conductivity in the Earth, "Erda" Gesellschaft für Wissenschaftliche Erderforschung m.b.H., and Dr. Richard Ambronn, German, both of Göttingen, Germany.

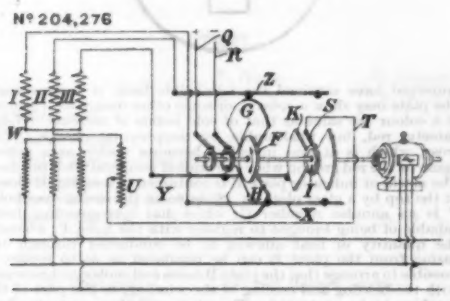
A number of devices are known for electrically discovering geological material, such as ore, water, oil, &c., the electric conductivity of which is very different from that of the material in which they are embedded. These devices comprise point electrodes or linear electrodes for earthing the electric current and producing the electric field, the equi-potential lines or equi-



potential areas of which on the surface of the earth or along boreholes being measured. The device, according to this invention, comprises surface electrodes for earthing the current, and they are shaped according to the purpose for which they are intended. The arrangement shown comprises a number of rods A, which are interconnected with each other by a wire B running to and fro successively over the several rods A, so as to form with the rods a kind of network covering a surface of suitable extension, the lines of flux going from one electrode surface through the subsoil to a similar electrode at a distant place.—*September 17th*, 1923.

204,276. March 27th, 1923.—Device for Mechanically Rectifying High-tension Polyphase Current, *Lodge-Cottrell, Limited, of 51, Great Charles-street and Church-street, Birmingham.*

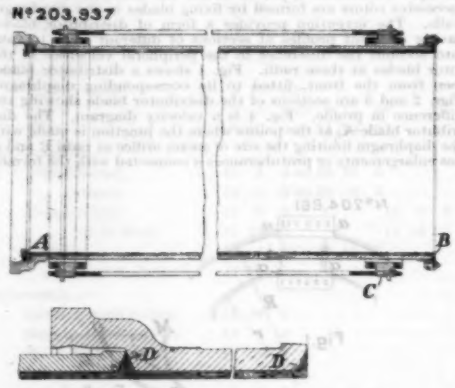
The present invention relates to a device for mechanically



rectifying high-tension polyphase current. The device operates in the following manner:—The currents produced in the individual phases I., II. and III. are synchronously conducted by means of the stationary polyphase current contacts X Y Z to the sectors G and H of the principal disc F, thus causing a pulsating direct current to flow in the leads Q and R. When the sector H leaves the contact Y—the shaft rotating in the direction indicated by an arrow—the sector K of the auxiliary disc I takes up the current flowing in the phase III. and returns it to the same phase by way of S T and U. Thus, an uninterrupted three-phase current will flow in the windings I., II. and III., and the pulsating current in Q and R will not be affected by compensating currents in the transformer W, and will assume the conventional theoretical wave form. The invention is of special importance for the production from high-tension polyphase current, of direct current to be employed in apparatus consuming high-tension current of small energy, such as, for example, electrical dust precipitators, Röntgen tubes, &c.—*September 27th*, 1923.

203,937. October 24th, 1922.—Concrete-lined Pipes, The Stanton Ironworks Company, Limited, near Nottingham, and P. H. Wilson, 1A, Hamilton-drive, The Park, Nottingham.

In this pipe, not only the bore, but also the exposed ends of each piece are protected by the concrete lining. Rings A and B



are clamped on to the cast iron pipe, leaving a slight space between their inner faces and the ends of the pipe. The pipe is mounted in the cage C and is rotated while the concrete is fed in, so that it is applied centrifugally and fills the spaces at the ends. Sprigs D are cast into the pipe to form a reinforcement for the concrete at the ends.—*September 20th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Electro-Harmonic Society.—Caxton Hall, Westminster, S.W. 1. Concert. 8 p.m.

Institute of Metals: Sheffield Local Section.—Mappin Hall of the University, St. George's-square, Sheffield. Sorby Lecture on "Metallurgical Problems, Present and Future," by Dr. W. Rosenhain, F.R.S. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Lecturette, "Amateur Cinematography," by Dr. C. K. Mees. 7.30 p.m.

Physical Society of London.—Imperial College of Science, South Kensington, S.W. 7. Ordinary meeting. 5 p.m.

SATURDAY, NOVEMBER 10TH.

Finsbury Old Students' Association.—The Engineers' Club, Coventry-street, London, W. 1. Twelfth annual dinner. 7 p.m.

Keighley Association of Engineers.—The Assembly Room, Cycling Club, Cavendish-street, Keighley. Paper, "Twenty-five Years' Progress in Machine Tools," by Mr. Isaac H. Wright. 6.30 p.m.

MONDAY, NOVEMBER 12TH.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Paper, "Nickel Alloys," by Mr. D. Turner. 7.30 p.m.

Institution of Automobile Engineers: Birmingham Centre.—Queen's Hotel, Birmingham. Informal meeting. 6.45 p.m.

Northampton Engineering College Engineering Society.—Northampton Engineering College, St. John-street, London, E.C. 1. Paper, "Turbo-compressors and Blowers," by Mr. A. J. D. Humby. 5.30 p.m.

Surveyors' Institution.—12, Great George-street, S.W. 1. Address by the president, Mr. J. I. Davidson. 8 p.m.

TUESDAY, NOVEMBER 13TH.

Illuminating Engineering Society.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Opening meeting. 8 p.m.

Institute of Marine Engineers.—85–88, The Minories, Tower-hill, E. 1. Adjourned discussion on "A Note upon Cast Iron for Marine Engine Castings from the Metallurgical and Engineering Points of View," by Messrs. H. J. Young and E. Wood. 6.30 p.m.

Institute of Metals: Birmingham Local Section.—Chamber of Commerce, New-street, Birmingham. Paper, "X-rays and Crystal Structure," by Dr. H. B. Keene. 7 p.m.

Institute of Metals: North-East Coast Local Section.—Armstrong College, Newcastle-on-Tyne. Paper, "General Scientific Brassfoundry Work," by Mr. P. Longmuir. 7.30 p.m.

Institution of Automobile Engineers: Coventry Centre.—Railway Hotel, Coventry. Discussion on the subject of "Limits." 7 p.m.

Institution of Electrical Engineers: Scottish Centre.—207, Bath-street, Glasgow. Inaugural address by Mr. R. B. Mitchell. 7.30 p.m.

Institution of Petroleum Technologists.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "Galician-Canadian Pole Tool Fishing Methods," by Mr. A. Miller. 5.30 p.m.

WEDNESDAY, NOVEMBER 14TH.

Institution of Automobile Engineers.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Paper, "The Misuse of the Internal Combustion Engine and Suggestions for its more Efficient Application," by Mr. L. Murphy. 6.30 p.m.

Institution of Chemical Engineers.—The Engineers' Club, Coventry-street, W. 1. Papers: "A Study of the Conditions of Constant Rate of Flow in Filter Presses," by Messrs. M. B. Donald and R. D. Hunneman; "A Study of the Absorption Tower," by Messrs. M. B. Donald and C. W. Tyson. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. Paper, "The Electric Transmission and Reproduction of Writing Designs and Photographs without Wires," by Monsieur Edouard Belin. 8 p.m.

Society of Technical Engineers: Manchester District.—Milton Hall, Deansgate, Manchester. Discussion, "The Function of the Staff Council in Industry." 7.30 p.m.

THURSDAY, NOVEMBER 15TH.

Institution of Automobile Engineers.—Watergate House, Adelphi, W.C. 2. London Graduates' meeting. Paper, "Noise," by Mr. A. O. Marshall. 7.30 p.m.

FRIDAY, NOVEMBER 16TH.

Institute of Metals: Sheffield Local Section.—The University, St. George's-square, Sheffield. Paper, "Substitutes for Platinum," by Mr. E. A. Smith. 7.30 p.m.

Institute of Metals: Swansea Local Section.—University College, Singleton Park, Swansea. Paper, "The Density of Alloys," by Professor T. Turner. 7.15 p.m.

Institution of Electrical Engineers: Scottish Centre, Students' Section.—Royal Technical College, Glasgow. Address by Mr. J. F. Nielson, chairman. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. "The Possibilities of Mercury as a Working Substance for Binary Fluid Turbines," by Mr. W. J. Kearton. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Annual general meeting. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Literary and Philosophical Society's Hall, Newcastle-upon-Tyne. Paper, "Essential Factors in Ship Propeller Design," by Mr. A. F. Ainslie. 7.30 p.m.

Society of Chemical Industry: Chemical Engineering Group.—Chemical Industry Club, 2, Whitehall Court, S.W. 1. Paper: "A New Source of Potash, and its Industrial Exploitation," by Professor J. W. Hinchley. 8 p.m.

West Bromwich Engineering Society.—Technical School, West Bromwich. Paper, "The Application of Science to Industry," by Dr. C. M. Walter. 7.30 p.m.

SATURDAY, NOVEMBER 17TH.

Institution of Municipal and County Engineers: Yorkshire District.—Meeting at Bradford. 2 p.m.

Junior Institution of Engineers.—Visit to the carriage and repair depôt of the Underground Railways at Acton. 2 p.m.

Keighley Association of Engineers.—Visit to the works of J. Parkinson and Son, Shipley. Train leaves Keighley 2 p.m.

MONDAY, NOVEMBER 19TH.

Institution of Automobile Engineers.—Royal Technical College, Glasgow. Paper, "The Misuse of the Internal Combustion Engine and Suggestions for its more Efficient Application," by Mr. L. Murphy. 7.30 p.m.

Institution of Automobile Engineers: Birmingham Centre.—Queen's Hotel, Birmingham. Dinner. 7.30 p.m.

TUESDAY, NOVEMBER 20TH.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Ormerod-road, Burnley. Paper, "The Founding of Admiralty Gun-metal and Allied Alloys," by Mr. F. W. Rowe. 7.15 p.m.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, E. 1. "Reversing Systems of Large Marine Oil Engines," by Miss V. Holmes, B.Sc. 6.30 p.m.

WEDNESDAY, NOVEMBER 21ST.

Association of Consulting Engineers.—St. Stephen's Club, Westminster, S.W. 1. Annual dinner. 7 for 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders: Graduate Section.—Neville Hall, Newcastle-on-Tyne. "The Mechanism of Gaseous Ignition," by Dr. W. M. Thornton. 7 p.m.

THURSDAY to THURSDAY, NOVEMBER 22ND TO 29TH.

Public Works, Roads and Transport Exhibition.—At the Royal Agricultural Hall, Islington, N. 1.

FRIDAY, NOVEMBER 29TH.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Lecturette, "Technical Arbitrations," by Mr. W. A. Tookey. 7.30 p.m.

FRIDAY, DECEMBER 7TH.

Junior Institution of Engineers.—Royal Society of Arts. Presidential address by Sir J. Fortescue Flannery, "Marine Propulsion during Fifty Years." 7.30 p.m.

CONTRACTS.

The Turbine Furnace Company, Limited, has, within the last four weeks, received orders for its furnaces for application to boilers employed in the textile, waterworks, gasworks, steel rolling mill, tin dredging, and colliery industries, about one-third of the orders being repeat orders.

Richard Garrett and Sons, Limited, of Leiston, have recently received from Hovis, Limited, an order for eleven of their latest 6-ton undertype steam wagons and 4-ton tracking trailers. Among the new features of these wagons is that roller bearings are fitted throughout.

J. W. Brooke and Co., Limited, of Lowestoft, have recently received a repeat order from a foreign Government to supply three 8–10 horse-power two-cylinder petrol engine sets specially intended for driving dynamos for wireless work. A feature of these plants is that they have to be transported for a considerable distance by camels, and for that reason they are, after test, dismantled and packed in separate cases; the total weight of each set does not exceed 150 lb., the cases being so arranged as to balance on the animal's back.